Study Guide for How to Inspect the Exterior Course

This study guide can help you:

- take notes;
- read and study offline;
- organize information; and
- prepare for assignments and assessments.

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Student Verification & Interactivity

Student Verification

By enrolling in this course, the student hereby attests that s/he is the person completing all coursework. S/he understands that having another person complete the coursework for him or her is fraudulent and will result in being denied course completion and corresponding credit hours.

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Communication on the message board or forum shall be of the person completing all coursework.

Objectives

Course Objectives

The purpose of this course is to provide accurate and useful information for performing an inspection of the exterior at a residential property. This course covers the components and materials of the exterior that may be present during a residential inspection, including siding, windows and doors, flashing, grading, the garage, and other exterior systems and components. The course covers the inspection process according to InterNACHI's Standards of Practice for Performing a General Home Inspection.

Learning Objectives

The student will demonstrate an understanding of this course's content by reading and studying the material, by taking the online course in its entirety, taking the practice quizzes at the end of selected sections, and successfully passing a timed online exam. After successful completion of this course, the student shall be able to perform an inspection of the exterior of a residential home according to the InterNACHI Residential Standards of Practice.

Section 3 of this course lists the particular section of the InterNACHI Residential Standards of Practice of the exterior inspection. The full text of the Standards is found at http://www.nachi.org/sop.htm.

If you are a home inspector in a state that requires licensure or certification, or if your state regulates property inspectors in some way, find out if regulations exist as to state-specific standards of practice. Such regulations are promulgated by the regulatory agency that administers the licensure, registration or certification of home inspectors.

Section 1: Inspection Tools

Inspection Tools

Inspectors should keep a basic toolkit readily available for every inspection, and some of these items are listed below. More in-depth and comprehensive inspections of the exterior can be conducted by using some specialized tools that are also included in this list.

First, make sure you're dressed for the job:

- **Overalls or coveralls** protect your clothes, and are handy when moving through a crawlspace or getting under a low deck or porch.

- You can put on some **shoe covers or booties** prior to entering the house that you are inspecting. Booties protect the floors. This demonstrates your care and consideration of your client's home.

- Personal protective equipment (PPE) includes a simple pair of **gloves**. Gloves protect your hands from insect bites, scratches from vegetation, dirt and soil, debris, splinters, and cuts from sharp edges of building components. There are different types for different situations, such as leather, canvas and rubber. Make sure they fit snugly.

- **Kneepads** protect your knees while you're crawling around, particularly when the ground surface is rough and covered with rocks and stones.

Some basic tools include the following:

- A **flashlight** is essential for inspecting under the deck or porch, behind dense vegetation, and in the shaded areas of the property, especially when access is limited.

- A **tape measure** can be used to measure the spacing of railing spindles, the rise and run measurements of stairs, the height of a railing, the width of an egress door, the area of visible damage, the dimensions of a joist, and much more.

- A **magnet** can be used to tell the difference between aluminum siding and steel siding, or galvanized steel flashing from copper flashing.

- A **level or plumb bob** can be used to check walls, posts and columns for plumb and level. A level can be used to check the slope of a walk, driveway, garage floor, and hard surface at the house's perimeter.

- A **screwdriver, awl or probe** can be used to check for wood rot or damage. A screwdriver may be needed to remove an access panel or some type of cover.

- **Binoculars** can be used to look where physical, up-close access is restricted. The soffit and fascia components cannot be inspected closely without the use of a ladder or binoculars.

- A **ladder** can be used to gain access to those higher-up areas that are not readily accessible or visible from the ground level. Many inspectors use a ladder to reach the gutter, eaves and roof.

Exterior inspections can be enhanced using the following specialized tools:

- A **moisture meter** can be used to detect or confirm moisture, as well as water intrusion problems, and wood that may be saturated with water. There are meters that are non-invasive and meters that have invasive probes. Learn more by taking InterNACHI's *How to Inspect for Moisture Intrusion* course athttp://www.nachi.org/moisturecourse.htm.

- You should be professionally trained and certified to use an **infrared camera**. Thermography is an effective tool to use when inspecting for moisture intrusion and for areas of energy loss. For an introductory course on infrared thermography, visit: http://www.nachi.tv/ppv/11.

Section 2: Inspection Procedures

Inspection Procedures

Step Back

Many inspectors begin each home inspection by inspecting the exterior. The exterior inspection should start by observing the home from the street or at the end of the driveway. Look at the house in its entirety. Check for things that may not be level, plumb or square. Many major structural problems will be apparent only when viewed from a distance. Up close, many things on the house may seem okay, but it's a different picture when the house is observed from farther away. Step back and take a few moments to look at the whole house. Check its outlining shape, its main design, and its structural features.

Figure out the various components of the house by stepping back. Identify the location of some of the systems, such as the electrical service, central cooling unit, egress opening, chimney structures, garage, parking area, side doors, fences, plumbing entrance, outlying exterior structures, landscaping features, property boundaries, shared utilities or components, and driveways and sidewalks, as well as inspection restrictions or obstacles, the prevailing wind direction, the southern-facing side of the house, and much more. Check the large trees that are near the house structure. From afar, you may be able to identify different types of siding

materials used on the house. By stepping back and looking at the house, you can get the big picture.

Move Closer

Next, move closer to the house and get a better, more detailed look. Many inspectors follow the front walk or driveway that leads to the house as they approach. You may choose a clockwise direction to move around the perimeter of the house. In this close-up inspection of the exterior, you are looking for details by getting behind vegetation, looking under things, and crawling under, reaching up, looking in, touching, measuring and probing.

Time

The exterior, including the roof system, may take up a third of the total time of the home inspection.

Water

Water is the main concern when inspecting the exterior. It is the greatest destroyer of houses.

Section 3: InterNACHI SOP

3.0 Introduction

This section covers the relevant portions of InterNACHI's Standards of Practice for Performing a General Home Inspection, including comments on the Standards, and what an inspector may observe outside on the house, including the exterior wall cladding. At the end of this section, you should be able to:

- list four things an inspector is required to inspect; and
- list four things an inspector is not required to inspect.

The Standards can be read in their entirety at http://www.nachi.org/sop.htm.

Inspectors can also take *Introduction to InterNACHI's Residential Standards of Practice* course online at http://www.nachi.org/intro-residential-sop-course.htm.

3.1 Residential Standards of Practice

The following information is excerpted from the InterNACHI Residential Standards of Practice for Performing a General Home Inspection. The Standards can be read in their entirety at http://www.nachi.org/sop.htm.

1. Definitions and Scope

1.1. A **general home inspection** is a non-invasive, visual examination of the accessible areas of a residential property (as delineated below), performed for a fee, which is designed to identify defects within specific systems and components defined by these Standards that are both observed and deemed material by the inspector. The scope of work may be modified by the Client and Inspector prior to the inspection process.

I. The general home inspection is based on the observations made on the date of the inspection, and not a prediction of future conditions.

II. The general home inspection will not reveal every issue that exists or ever could exist, but only those material defects observed on the date of the inspection.

1.2. A **material defect** is a specific issue with a system or component of a residential property that may have a significant, adverse impact on the value of the property, or that poses an unreasonable risk to people. The fact that a system or component is near, at or beyond the end of its normal useful life is not, in itself, a material defect.

1.3. A **general home inspection report** shall identify, in written format, defects within specific systems and components defined by these Standards that are both observed and deemed material by the inspector. Inspection reports may include additional comments and recommendations.

[...]

3.2. Exterior

I. The inspector shall inspect:

A. the exterior wall-covering material, flashing and trim;
B. all exterior doors;
C. stairs, steps, stoops, stairways and ramps;
D. porches, decks and balconies;
E. railings, guards and handrails;
F. the eaves, soffits and fascia;
G. a representative number of windows; and
H. vegetation, surface drainage, retaining walls and grading of the property, when they may adversely affect the structure due to moisture intrusion.

II. The inspector shall report:

A. as in need of correction any improper spacing between intermediate balusters, spindles and rails.

III. The inspector is not required to:

A. inspect or operate screens, storm windows, shutters, awnings, fences, outbuildings, or exterior accent lighting.
B. inspect items that are not visible or readily accessible from the ground, including window and door flashing.
C. inspect or identify geological, geotechnical, hydrological or soil conditions.
D. inspect recreational facilities or playground equipment.
E. inspect seawalls, breakwalls or docks.
F. inspect erosion-control or earth-stabilization measures.
G. inspect for safety-type glass.
H. inspect underground utilities.
I. inspect underground items.
J. inspect wells or springs.
K. inspect solar, wind or geothermal systems.
L. inspect swimming pools or spas.
M. inspect wastewater treatment systems, septic systems or cesspools.
N. inspect irrigation or sprinkler systems.
O. inspect drainfields or dry wells.
P. determine the integrity of multiple-pane window glazing or thermal window seals.

Also, as listed in the SOP under 2.2. Exclusions, the inspector is not required to determine property boundary lines or encroachments.

3.2 Comments

When we inspect the exterior of a residential house, we are not providing an architectural service. We are not practicing the art and science of building design for the construction of any structure. We are not commenting upon the use of the space within or the surrounding structures, or the design or design development, or the preparation of construction contract documents, or the administration of the construction contract. We are strictly adhering to the InterNACHI Residential Standards of Practice. We are employing the best non-invasive, visual-only inspection techniques to perform the inspection of the exterior.

The inspection is not technically exhaustive. That means that the inspection is not a comprehensive or detailed examination beyond the scope of a real estate home inspection, which would involve or include, but would not be limited to: dismantling, specialized knowledge or training, special equipment, measurements, calculations, testing, research, analysis, or other means.

Consider communicating to your client that there may be problems with the property that exist during the inspection that will not be found or discovered because they are beyond the scope of the home inspection.

We inspect the exterior. That means that we have to visually look at readily accessible systems and components safely, using normal operating controls, and accessing readily accessible panels and areas in accordance with the Standards of Practice. Something is accessible if it can be approached or entered by the inspector safely and without difficulty, fear or danger.

A component is defined as a permanently installed or attached fixture, element or part of a system. A piece of kickout flashing at the gutter area is an example of a component of a stucco siding system.

We can activate a component. Activating means to turn on, supply power to or enable systems, equipment or devices to become active by normal operating controls. An example would be to turn on the exterior light fixture at the entry door area.

The condition of a component is its visible and conspicuous state. An inspector can report the component's condition as being functional. A component can be functional, or performing, or able to perform, a function. A physically damaged light fixture that is in pieces is in a condition that is not functional.

In the inspection report, we can describe, in written format, a system or component by its type or other observed characteristics in order to distinguish it from other components used for the same purpose.

An inspector is required to describe and identify, in written format, material defects observed. A material defect is a condition of a residential real property, or any portion of it, that would have a significant, adverse impact on the value of the real property, or that involves an unreasonable risk to people on the property.

Inspection reports may contain recommendations regarding conditions reported, or recommendations for correction, monitoring or further evaluation by professionals, but this is not required.

At the exterior, the inspector shall look at the siding or exterior wall cladding. We are required to inspect and describe the exterior wall covering. We should be able to identify the type of stucco or EIFS that is installed (if present). We should be able to identify the type of wood siding installed (if present). We also have to look at the associated flashing and trim, but only those items, including window and door flashing, which are visible or readily accessible from the ground.

We are not required to use a ladder to inspect the exterior of a house. We are not required to move a ladder from place to place or from upper-floor window to upper-floor window. Many inspectors use binoculars to get a better look at components that are above their heads. When moving around the house, look up and inspect the eaves, soffits and fascia components.

Inspectors should look at all of the exterior doors. While inspecting each exterior door, you may consider checking each storm door (if present). One of the most common problems with a storm door is the retractor mechanism. The weatherstripping is often in need of repair or replacement.
We are required to inspect only a representative number of windows. When an inspector moves around the exterior, it may be that the first-floor windows are more accessible than any second-floor windows. Some inspectors will move a ladder to a particular window that is above what is readily accessible, but this is not required.

We are not required to inspect for safety-type glass at the sliding glass doors, for example. Inspectors should report as in need of repair any windows that are obviously fogged or display other evidence of condensation caused by lost seals.

When we walk around the house, we should check the decks, stoops, steps, stairs,

porches and railings. We should report to our client any spacing between intermediate balusters, spindles or rails for steps, stairways, balconies and railings that would permit the passage of an object greater than 4 inches in diameter.

Part of the inspection of the exterior includes checking the vegetation. We don't want any vegetation, bushes or trees in direct contact with the house's exterior cladding.

The surface drainage should be proper. We do not have to inspect underground items, such as surface-water drainage systems. An inspector should be able to report the condition of the grading when that grading may have an adverse effect on the structure.

The condition of retaining walls should be inspected, especially when the retaining wall is likely to adversely affect the structure. We are not required to inspect for erosion-control and earth-stabilization measures. Inspectors are not required to inspect seawalls, breakwaters or breakwalls, or docks.

The inspector is not required to inspect or operate screens, storm windows, storm doors, shutters or awnings, although some inspector may include these components out of courtesy.

We do not have to inspect fences, but many inspectors do if they believe that the fence may affect the structure of the house. Many decks, patios and landscaping have exterior accent lighting, but that type of lighting is not within the scope of a home inspection.

The exterior inspection does not include outbuildings. Many inspectors charge an additional fee to inspect outbuildings. Home inspectors are not required to inspect recreational facilities or playground equipment.

Many inspectors include the inspection of a garage or carport with the inspection of the exterior. According to the InterNACHI Residential Standards of Practice, you are not required to inspect the garage or carport. If the garage is detached or a carport is present, the inspector may charge an extra fee to include that in the inspection. The inspector is required to inspect the garage door and garage door opener by operating it by remote control (if available), and then by the installed automatic door control.

In summary, an inspector should be able to inspect and identify all of the major systems and components of the exterior. An inspection report shall describe and identify, in written format, the inspected systems, structures and components of the dwelling, and shall identify material defects observed. Inspection reports may contain recommendations regarding conditions reported, or recommendations for correction, monitoring or further evaluation by professionals, but this is not required.

Quiz 1

T/F: The inspector shall inspect all exterior doors.

- True
- False

T/F: The inspector shall inspect the fascias.

- True
- False

T/F: The inspector shall inspect all of the windows.

- False
- True

T/F: The inspector shall describe the exterior wall covering.

- True
- False

T/F: The inspector shall inspect the flashing that is not visible or readily accessible from the ground.

- False
- True

T/F: The inspector shall inspect for safety-type glass.

- False
- True

Section 4: Exterior Details and Components

Identification

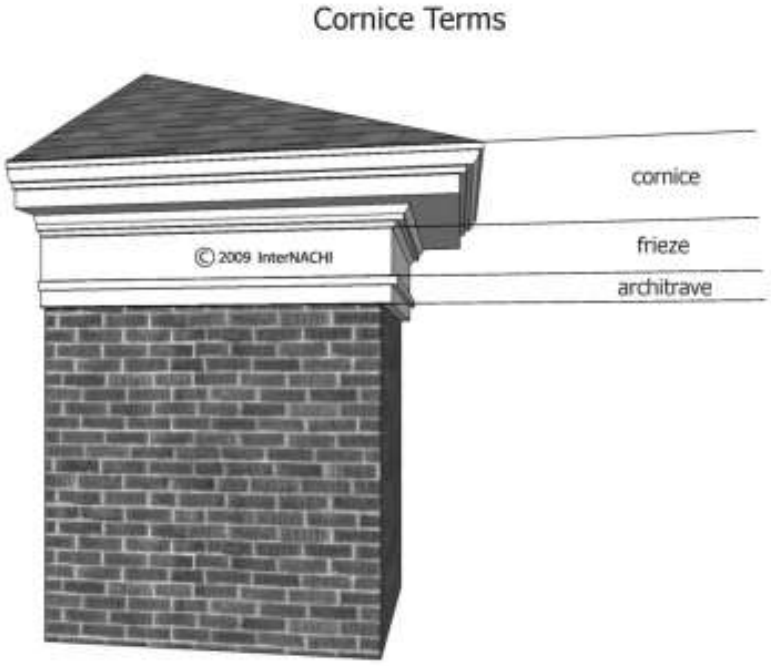
This section deals with the common building details and styles that may be observed during an inspection of the exterior.

At the end of this section, you should be able to identify and describe some common architectural details of a residential property.

Cornice

A cornice can be any horizontal decorative trim located at the top of any building or architectural element. The term cornice comes from the Italian *cornice*, meaning "ledge." A cornice usually refers to the horizontal decorative trim at the top of an exterior wall and below the roof edge of a building, but a cornice can be over a door or window.

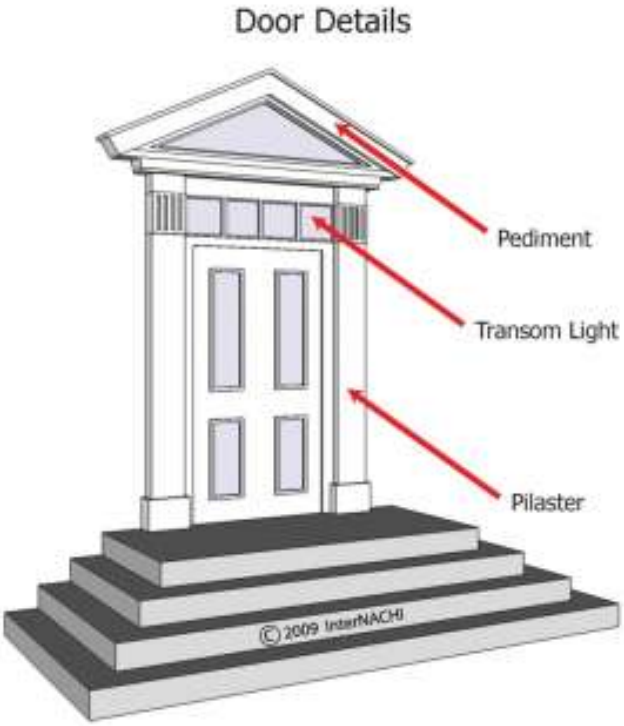
The function of the projecting cornice is to throw rainwater free of a building's walls. At a residential home, this function is handled by projecting gable ends, roof eaves and gutters. The cornice may include decorative trim. Highly decorative trim is often called an entablature.



Entablature

An entablature is a major element of classical architecture. It can refer to the structure of moldings and bands located horizontally above columns. It can be divided into the architrave (the supporting member), the frieze (a strip that may or may not be ornamented), and the cornice (the projecting member).

Pediment



A pediment is a classical architectural element consisting of the triangular space found above the horizontal structure (entablature) or columns. Pediments can be found over doors and entries. They can be straight, curved or broken. A pediment is typically found at a porch roof or above an exterior door at a residential house. Take a look at the Door Details illustration above.

Portico

A portico (from the Italian) is a porch leading to the entrance of a building with a roof structure over a walkway, and supported by columns or enclosed by walls.

Dentils

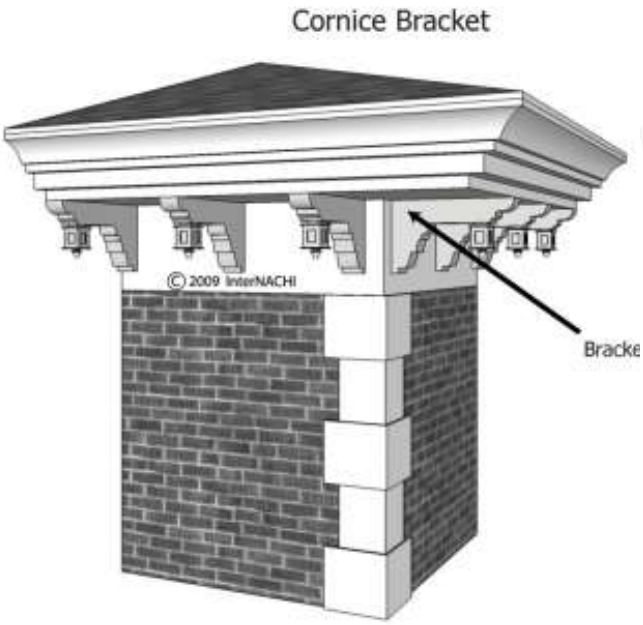
A cornice may have dentils. A dentil (Latin for "tooth") is a small, tooth-shaped block used as a repeating ornament within a cornice.

Bracket

Brackets are ornamental supports that appear at the cornice. They may be shaped into scrolled patterns or be more simple. Brackets are often found in pairs.

Eaves

An eave is the edge of a roof. Eaves can provide weather protection by projecting beyond the exterior wall of the building. Some buildings, such as Craftsman bungalows, have very wide eaves with decorative brackets. The term eave may also refer to the lower part of a sloped roof that projects beyond the wall or soffit. In solar building practices, the eave may be extended to control the amount of sunlight and heat entering a window.

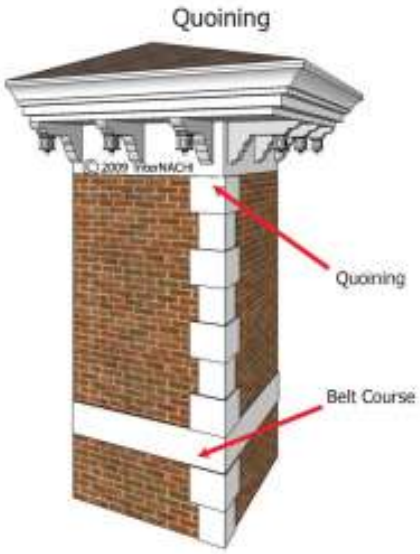


Quoin

Quoins are used as a detail at the corner of two walls. Quoins typically project from the face of the walls on both sides of the corner. Quoins can function as the cornerstones of brick or stone walls. Quoins may be structural, or may be simply decorative. The most common form of decorative use for quoins is as an alternating pattern of rectangular blocks that wrap around the wall, mimicking the pattern of stone blocks or bricks as they would wrap around a corner and thus join the two walls.

Architects and builders use quoins to give the impression of strength and firmness to the outline of a building. Quoins are often used on houses that are stucco-clad to give the same impression.

Quoins usually extend the full height of the walls. They can appear to be of a different color, shape or texture than the rest of the wall.



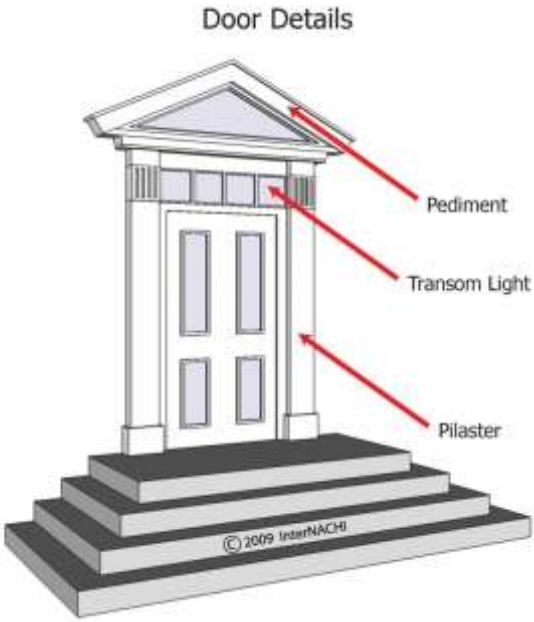
Columns

A column typically refers to a vertical structural element that transmits the weight of the structure above to other structural elements below. A column can have certain proportional and decorative features.

Columns can be structurally functional or simply decorative. Columns can be round, square, rectangular, straight or tapered. Column styles are defined by their capitals, which are the tops of the columns. If the column projects from the house wall, it is commonly called a pilaster.

Pilaster

There are two types of pilasters: structural and ornamental. Some structural pilasters can appear ornate. Most structural pilasters lack decorative bases and capitals of historical precedent. Incorporating structural pilasters, which might appear as thick and strong wall sections at intervals, can be a way to provide lateral support. Structural pilasters built within the wall's thickness can project on one side or could be flush, depending mostly on aesthetic preference rather than by structural considerations. Most masonry structural pilasters are built as an integral part of the masonry wall. An inspector may find a steel pilaster being used to increase the strength or vertical stiffness of a concrete block foundation wall.



The ornamental pilaster, identified in the Door Details illustration above, is used to give the appearance of a structurally supporting column.

Quiz 2

A(n) _____ is a classical architectural element consisting of the triangular space found above the horizontal structure or columns.

- pediment
- cornice
- eaves
- portico

A(n) _____ usually refers to the horizontal decorative trim at the top of an exterior wall and below the roof edge of a building, but it can be found over a door or window, too.

- cornice
- entablature
- portico
- pediment

A _____ is a porch leading to the entrance of a building with a roof structure over a walkway, and supported by columns or enclosed by walls.

- portico
- door
- bracket
- dentil

_____ are used as a detail at the corner of two walls, which typically project from the face of the walls on both sides of the corner.

- Quoins
- Porticos
- Columns
- Eaves

A _____ refers to a vertical structural element that transmits the weight of the structure above to other structural elements below.

- column
- lite
- transom
- pediment

Section 5: Doors

Doors

This section deals with the common details and styles of doors that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- list the different types of the most common doors;
- describe how each type of door operates; and
- list the components of a typical panel door.

A door is a moveable barrier used to cover an opening. A door can be opened to provide egress. It can be closed and secured using a lock. When a door is open, it brings in light and ventilation. Doors assist in preventing the spread of fire. Doors can reduce noise.

There are all kinds of doors. There are many names for doors depending upon their purpose.
The most common type of door consists of a single rigid panel that fills the doorway.

Different types of doors are listed below.

- A Dutch door is divided in half horizontally.
- Saloon doors are a pair of swinging doors often found in public bars.
- A blind door is designed to blend in with the adjacent wall finish.
- A French door has window panes that fill the full length of the door.
- A louvered door has fixed or movable wooden fins.
- A flush door is completely smooth, with a hollow-core interior, used primarily as an interior door.
- A moulded door has a similar structure as that of a flush door, but the skin surface is moulded.
- A brace door is made from vertical planks secured together by two horizontal planks and kept
  square by a diagonal plank.
- A bi-fold door has several sections that fold in pairs.
- A sliding glass door is made of glass, slides open, and sometimes has a screen.

Hinged

Most doors are hinged along one side. The door swings or pivots away from the opening in one direction. A swing door has hinges that allow it to swing either

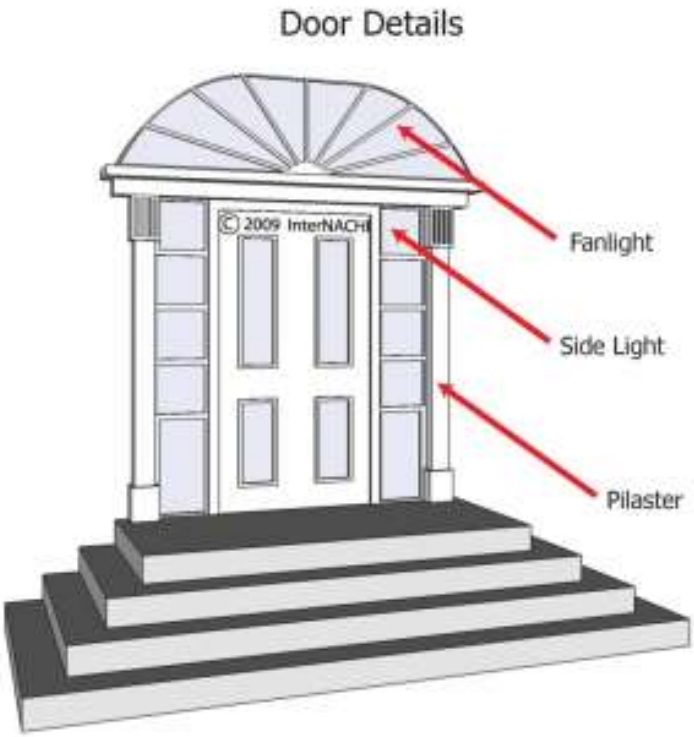
outward or inward. Typical French doors have two swinging door panels that swing either in or out.

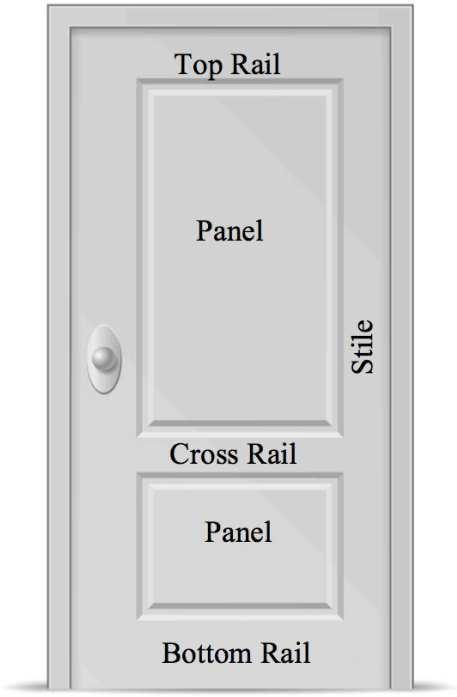
Sliding

Sliding doors move along the horizontal plane. The bottom of a slider door has wheels with grooves that keep the bottom of the door steady on a track. Slider doors are commonly found at the rear of a house leading to a backyard, patio or deck. Doors that slide inside a pocket cavity inside a wall are called pocket doors.

Door Components

Exterior doors are typically panel doors, or moulded doors that appear to be panel doors. Panel doors are also called stile and rail doors. Panel doors are built with frame-and-panel construction components.





Stiles

Stiles are vertical boards that run the full height of a door and compose its right and left edges. The hinges are mounted to the fixed side, known as the hanging stile. The handle, lock, bolt and/or latch are mounted on the swinging side, known as the latch stile.

Rails

Rails are horizontal boards at the top, bottom and (optionally) in the middle of a door that join the two stiles. The top rail and bottom rail are named for their positions. The bottom rail is also known as the kick rail. A middle rail at the height of the door bolt is called the lock rail.

Panels

Panels are large, wide boards that fill the space between the stiles, rails, and mullions. The panels typically fit into grooves in the other pieces and help to keep the door rigid. Panels may be flat or raised in raised-panel designs.

Mullions

These are smaller, optional vertical boards that run between two rails and split the door into two or more columns of panels.

Muntins

These are the vertical members that divide the door into smaller panels.

Lites

Lites are pieces of glass used in place of a panel, essentially giving the door a window.

Section 6: Windows

This section deals with the common details and styles of windows that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- list the different types of the most common windows;
- describe how each type of window operates; and
- list the components of a typical double-hung window.

Fixed

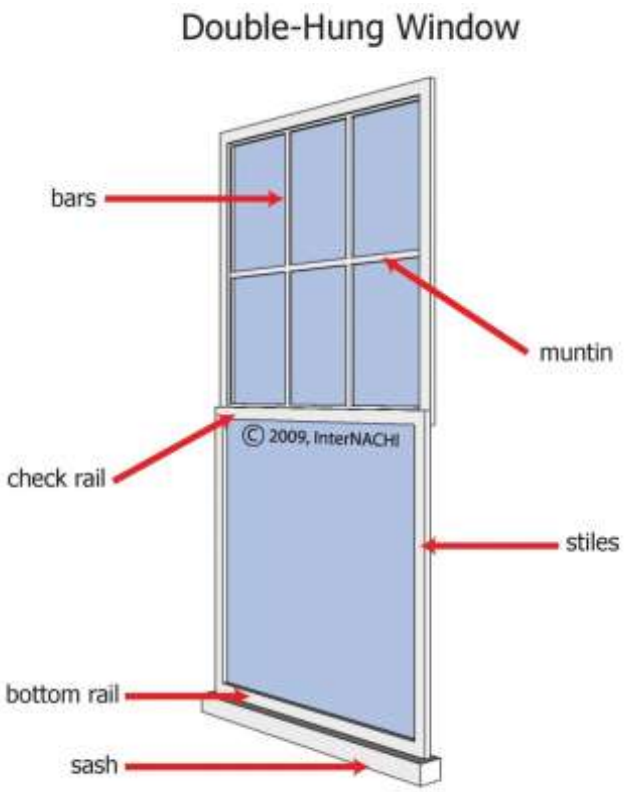
Fixed windows are sometimes referred to as picture windows. A fixed window does not open.

Picture Window

A picture window is a very large fixed window in a wall. Picture windows are intended to provide an unimpeded view.

Double-Hung

A double-hung window has two operable sashes that move. Many older and historic homes have double-hung windows. This window is a traditional style of window in the U.S. The window has two parts (sashes) that overlap slightly and slide up and down inside the frame. Most new double-hung sash windows use spring balances to support the sashes. Traditionally, counterweights were used. The weights are attached to the sashes using pulleys of either a cord or chain.



Horizontal-Sliding

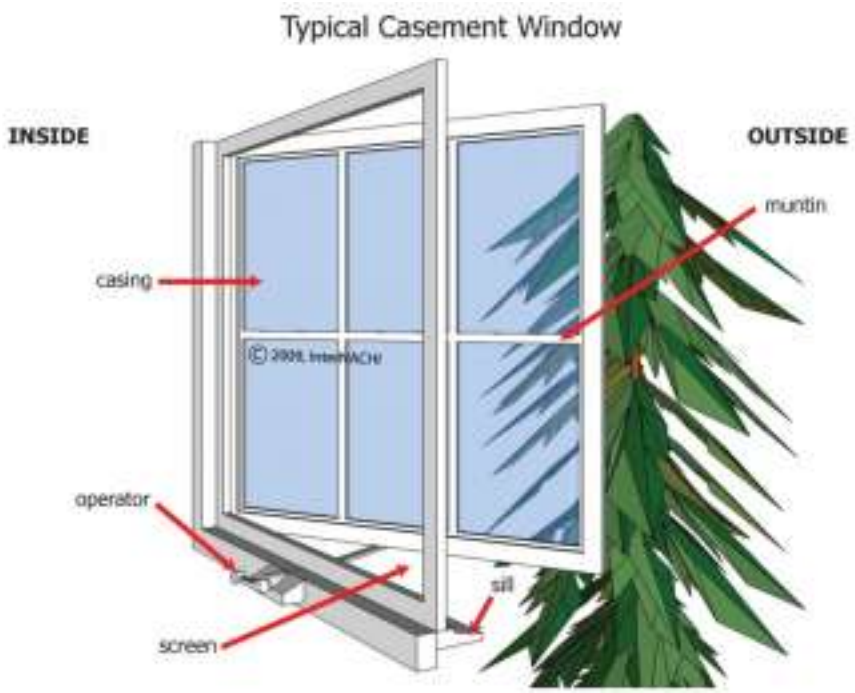
A horizontal-sliding sash window has two or more sashes that overlap slightly and slide horizontally within the frame. In the United Kingdom, these are sometimes called Yorkshire sash windows. The entire window may have sliders or, more typically, only one sash will slide. These sliders are similar to patio door sliders, where one slider door is fixed and the other slides.

Single-Hung

Single-hung windows have a fixed and an operable sash. The operable sash is usually located on the bottom, and the fixed sash is located at the top of the window.

Casement

A casement window is one that is hinged, usually at the side, and sometimes at the top or bottom. The sash swings in or out much like a door, comprised of a side-hung, top-hung or bottom-hung sash, or a combination of these types. In the U.S., these windows are usually opened using a crank. In Europe, they tend to use friction mechanisms and espagnolette locking. A crank, stay or friction hinge is necessary when the window opens outward in order to hold the window in position.



Awning (Casement) Window

An awning window is a casement window that is hinged at the top. The window hangs horizontally by the hinges. It swings outward like an awning. It typically opens outward and operates with a crank.

Hopper (Casement) Window

A hopper window is a casement window that has hinges on the bottom. Usually, the window opens inward, toward the living space, rather than outward.

Jalousie or Louver

A jalousie window consists of parallel glass and acrylic or wooden louvers set in a frame. The louvers are locked together onto a track so that they may be tilted open and shut in unison to control air flow through the window. When the window is closed, the louvers overlap each other in a shingle pattern.

Jalousie windows are best suited for porches that are not climate-controlled and are in mild-winter climates. They are common on mid-20th-century homes in Florida and other southern states in the U.S. They are also common in Hawaii.

They are good for providing ventilation. They are not weathertight. They are not good insulators in northern climates if energy efficiency is a concern. They can remain open during rain and yet keep most of the rain from entering because of the shingle orientation.

Transom

A transom window is located above a door. In an exterior door, the transom window is typically fixed. In an interior door, it may open. In an older house, the function of an interior transom window that opens was to provide ventilation before the forced-air HVAC system was introduced.

Bay Window

A bay window is a multi-panel window with at least two panels set at different angles to create a projection from the wall.

Emergency Escape and Egress

This is a window designed to allow occupants to escape through the opening in an

emergency, such as a fire. In the United States, specifications for emergency windows in bedrooms are given in many building codes.

Deck Obstructing Emergency Egress

Lite/Light

The terms “lite” and “light” are interchangeable and refer to a glass pane. Several lites may be installed in a window. For example, a fixed window has one lite. A single-light can refer to one piece of glass in a sash. A horizontal slider has two lites, with one sash fixed and the other a slider. A double-light refers to two lites of a window.

Muntins

The lites in a window sash are divided horizontally and vertically by narrow strips of wood or metal called muntins. Muntins divide a sash into smaller lites or panes. In many modern windows, the muntins are not true muntins, but are decorative only. Fake muntins are mounted either on the interior-side of the glass, or they are installed between two panes of a double-glazed window. They may be made of wood, metal or plastic. In the U.K., these are called glazing bars.

Mullion

A mullion is a structural element that divides adjacent window units. “Mullion” is often confused with “muntin," which is the term for the small strips of wood or metal that divide a sash into smaller glass panes or lites.

A mullion acts as a structural member, and it carries the dead load of the weight above the opening.

Quiz 3

A _____ window has two operable sashes that move.

- double-hung
- single-pane
- casement
- top-hung

The sash of a(n) _____ window swings in or out.

- casement
- awning
- double-hung
- jalousie

A _____ window has hinges on the bottom and opens inward toward the living space.

- hopper
- sliding
- flopper
- single-hung

A _____ window is located above the door.

- transom
- single-pane
- lite
- bay

The lites in a window sash are divided horizontally and vertically by narrow strips of wood or metal called _____.

- muntins
- strips
- lights
- mullions

_____ are vertical boards that run the full height of a door and compose its right and left edges.

- Stiles
- Rails
- Mullions
- Muntins

_____ are the horizontal boards at the top, bottom and (optionally) in the middle of a door that join the two stiles.

- Rails
- Stiles
- Mullions
- Muntins

Section 7: Siding

7.1 Siding: The Basics

This section deals with the general description of the wall envelope that is observed during an inspection of a home's exterior.

At the end of this section, you should be able to:

- list the systems and components included in the wall envelope; and
- describe the function of siding.

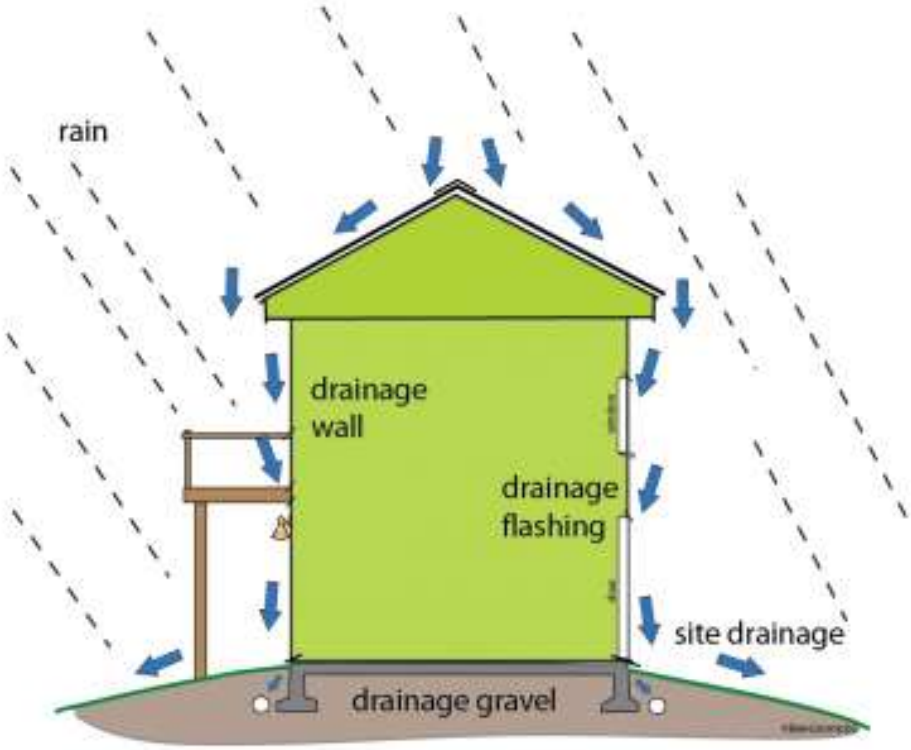
Wall Envelope

Exterior walls provide the house with a weather-resistant exterior wall envelope. The exterior wall envelope (or building envelope) includes the following components and systems:

- siding (or cladding);
- roof covering;
- glazing;
- exterior walls, windows and door assemblies;
- skylight assemblies (if present); and
- other components that enclose the house.

The exterior wall envelope should be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer (or exterior wall covering), and a means of draining water that enters or passes through the siding to the exterior. Siding is that which is installed on the outer surface of the exterior wall envelope.

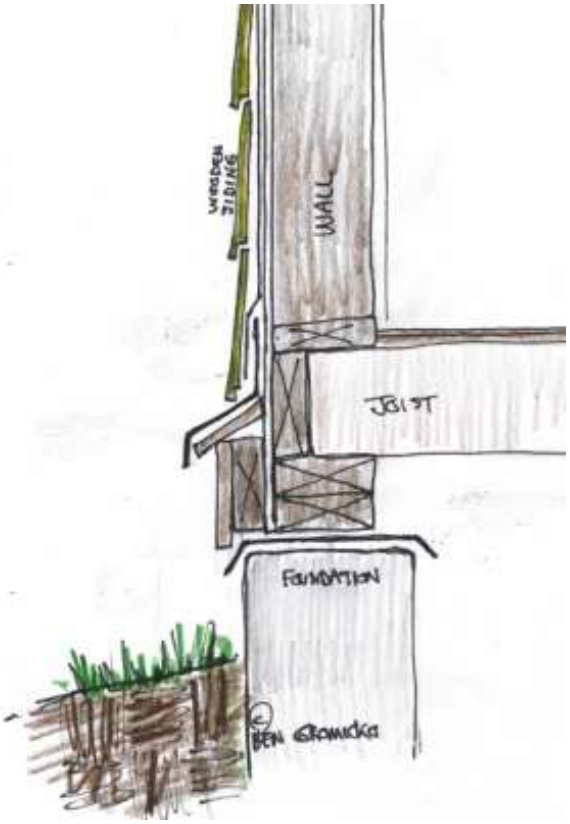
The building envelope can be a weak and susceptible system of a house. Siding failures often result in water intrusion and major structural problems over a large section of the house. A small component of the siding may result in disproportionately greater structural damage.



Siding

For this course, the term “siding” includes the exterior wall covering and cladding. All of these terms are used interchangeably. The siding system includes:

- wall surfaces;
- eaves, soffit and fascia;
- windows and doors;
- trim and flashing; and
- sealant or caulking.



Siding is the exterior wall covering or cladding of a house. It is the "skin" of a house's exterior. Its primary function is to keep out the weather and provide the building’s aesthetic look. It protects against wind, rain and snow. It takes a blow from a baseball or the scraping from a tree branch. Apart from providing the external appearance of the house, the primary

function of cladding is to protect the structure from weather, particularly to shed rainwater. This may be achieved by using one of the following:

- porous materials. Porous materials, such as brick, absorb water during rain and subsequently dry out. If the wall is thick and the permeability is low, the water will not penetrate during a rainstorm. A cavity is normally designed in the wall of porous materials to provide a pathway for possible water intrusion;

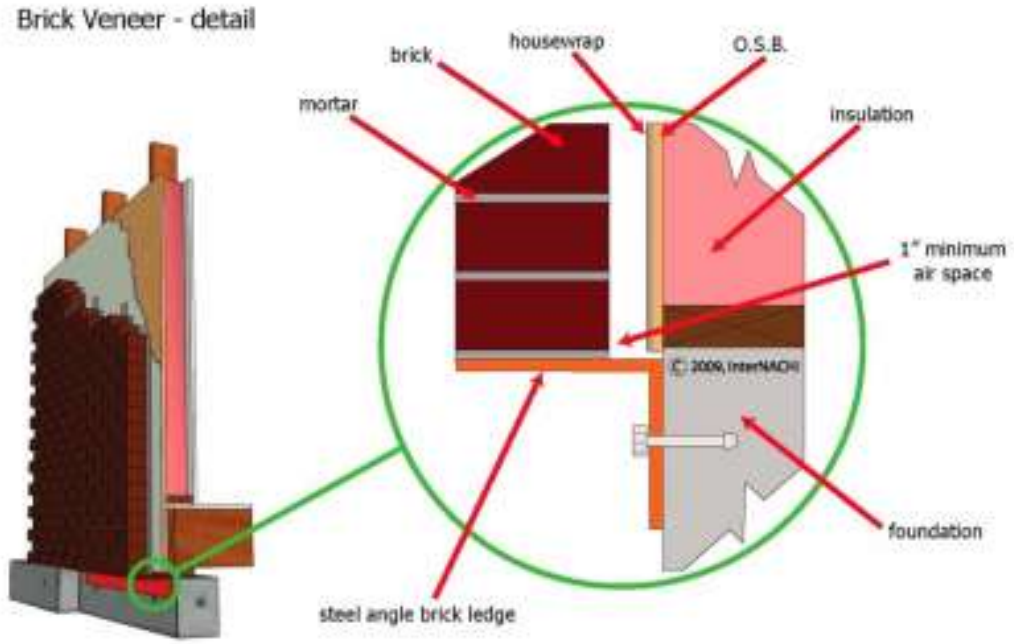
- sealed construction. Impermeable siding materials permit the intrusion of water only at the joints. Sealing the joints creates an impermeable layer that is continuous; or

- a rainscreen. The purpose of a rainscreen siding material is to protect the wall from direct rain. The joints may allow some water penetration, but an air gap and water-resistant barrier behind the siding limit the penetration. An air gap with ventilation is designed into the wall to encourage drying out.

Fastening

Many siding materials are held in place securely with fasteners, including nails. Siding is usually nailed through the sheathing and into the structural members, such as studs.

Masonry veneer walls use brick metal ties to hold the brick wall in place, secured to the house's exterior wall framing.



Stone and brick used as exterior siding materials need support to hold their weight, such as a foundation, footing or ledge. Vinyl cladding is lighter in weight and can simply be attached to the framing by nails or hung with fasteners.

7.2 Insulation Value of Siding

Siding material is not considered insulation. Typically, siding is not a good insulator. Siding sold with thin, insulated panels can provide a little insulation value, but not enough to be calculated as a significant energy-saving benefit. True insulation building materials include fiberglass, cellulose, foam, and ridge sheet siding.

For houses that were constructed in the 1950s, insulated siding was considered a big benefit because the walls of these older homes were barely insulated. Nowadays, the insulation value of siding materials is minor compared to a modern home with properly, well-insulated walls.

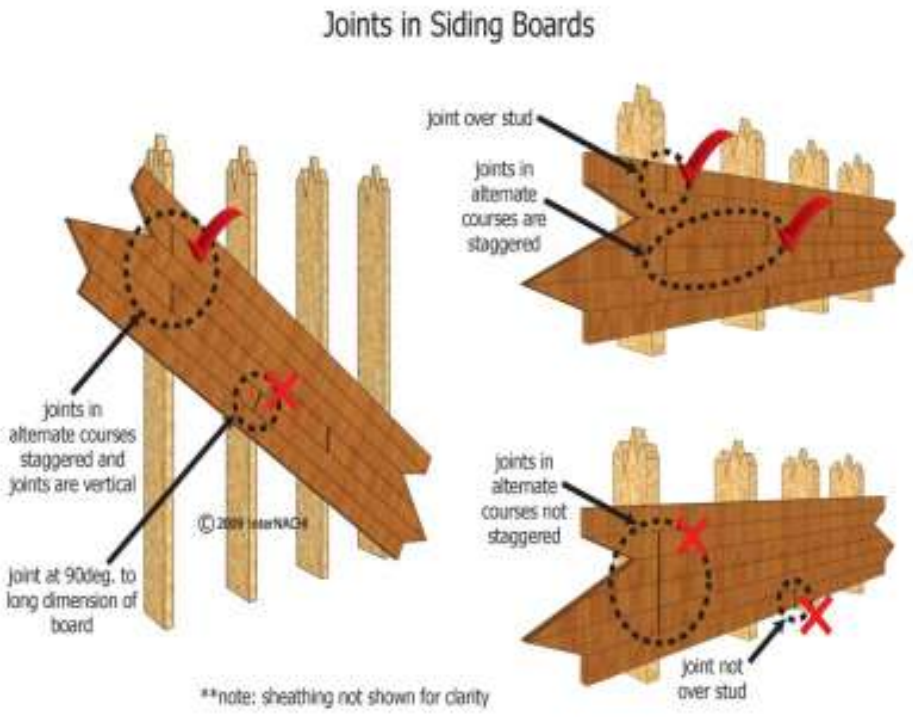
Some construction practices include installing large, rigid sheets of insulation behind the siding that is being installed. The insulation may be made of polystyrene, polyurethane or polyisocyanurate. The insulation sheets will noticeably increase the insulation value of the wall.

Careful consideration must be made when deciding to install large, rigid sheets of insulation on older houses that do not have a continuous interior vapor-retarder. The insulation may trap moisture in the wall behind the insulation, eventually causing water damage. The moisture problem is reduced if very thick, rigid sheets of insulation are installed instead of thin ones. The thicker insulation will keep the wall warm and prevent condensation formation inside the wall. A Canadian practice is to add this type of insulation with an R-value that is two times that of the value of the wall.

There have been problems with installing some siding materials over large, rigid sheets of insulation. Wood siding can crack if not installed properly over this type of insulation. The manufacturer's recommendation must be considered when the siding is installed.

7.3 Siding Types

There are many different types of siding. As an inspector, you may see a wide variety of materials installed on the outside of houses. Siding may be made of wood, metal, plastic (vinyl), masonry, or composite materials. It may be attached directly to the building's structure or to an intermediate layer of sheathing. You may see shingles or shakes, bricks or stone, aluminum or vinyl, or combinations of siding materials on the same home. You may see siding that is painted or stained, or wood siding on top of brick, or stucco installed on top of steel siding materials. You may see wood siding installed vertically, horizontally or diagonally.



The following types of siding are commonly used over wood-frame and masonry construction:

- aluminum siding;

- cement-fiber panels or siding;
- exterior insulation finish systems (EIFS);
- stucco;
- vinyl;
- wood panels or siding; and
- masonry, brick and stone.

Each of these coverings differs in performance as well as permeability. The most common sidings are wood-based, such as solid wood, plywood, shingles, shakes, hardboard and particleboard.

While vinyl is a non-permeable material, vinyl siding is designed to be water-resistant – not waterproof. Vinyl siding is not designed to prevent water intrusion. All siding is designed to shed water, but concrete and masonry materials are known to absorb water and release it through evaporation.

Siding may be formed of horizontal boards, vertical boards (known in many countries as weatherboarding), shingles and sheet materials. In all four cases, avoiding wind and rain infiltration through the joints is a major challenge met by overlapping, by covering or sealing the joint, or by creating an interlocking joint.

The next sections cover the following types and materials of siding:

- wood;
- metal;
- vinyl;
- brick, stone and concrete;
- stucco and EIFS;
- asphalt shingles;
- cement-based siding;
- clay and slate shingles; and
- plywood, hardboard and oriented strand board (OSB).

These sections discuss how to recognize each type of the siding materials, what problems may arise, and how to find those problems when inspecting the siding.

There is a wealth of information that can be drawn from other sources about siding. InterNACHI encourages you to continue to learn about siding throughout your entire career as a home inspector.

Some issues related to siding are not covered in detail in this course because they are beyond the visual scope of a home inspection, or because there are different requirements among different geographical areas and municipal authorities. We encourage you to understand what is required in your part of the country and what is required by your local authority having jurisdiction (AHJ).

These issues include, but are not limited to, the requirements related to:

- sheathing;
- thickness;
- minimum fastening and support;
- building paper or housewrap;
- acceptable materials; and
- installation methods.

General Requirements

There are general requirements for all exterior siding systems. The general requirements include:

- providing the house with a weather-resistant envelope;
- having functional flashing;
- preventing water intrusion into the walls; and
- protecting against condensation.

Layers

The siding should not be considered the only barrier to water intrusion. The housewrap, flashings and underlayment must be used to shed and direct water away from the building. The best principle is to have layers of materials installed so that water cannot get behind any one layer and into an opening.

High Wind

Exterior walls are designed and built to withstand code-specified wind speeds. Basic wind speeds can be found using wind maps. Wind speeds are generally greater in coastal areas, so the effects of high winds on exterior wall covering materials are a primary concern. The basic wind speeds as related to building cladding are up to 110 mph. In areas where the basic wind speed is greater than 110 mph, special building codes, standards and practices should be applied.

7.4 Siding Materials Chart

SIDING MATERIALS							
Material	**Durability**	**Accepts Staining**	**Accepts Painting**	**Maintenance Requirements**	**Weathertight-ness**	**Resistance to Damage**	**Insulative Value**
WOOD SIDING							
Solid Wood	Fair	Good	Fair	Low, unless painted	Good	Good	Poor
Plywood	Fair	Good	Fair	High	Good	Fair	Poor
Shingles and shakes	Fair	Good	Fair	Low, unless painted	Good	Poor	Poor
Hardboard	Poor	Fair	Good	Low, if pre-finished	Good	Fair	Poor
Overlaid particleboard	Poor	Fair	Good	Low, unless painted	Good	Fair	Poor
METAL SIDING							
Aluminum	Fair	n/a	Fair	Low	Good	Poor	Poor
Steel	Fair	n/a	Fair	Low	Good	Good	Poor
SYNTHETIC SIDING							
Vinyl	Fair	n/a	Poor	Low	Good	Good	Poor
Fiberglass-reinforced plastic	*	n/a	Poor	Low	Good	Good	Poor
Manufactured stone	*	n/a	Poor	Low	Good	Good	Poor
Insulated panels	*	n/a	*	*	Good	Good	Good
MASONRY SIDING & COVERING							
Brick	Good	n/a	Good	Low	Varies with porosity	Good	Poor
Stone	Good	n/a	Good	Low	Varies with porosity	Good	Poor
Stucco/EIFS	Fair	n/a	Fair	Low	Fair	Fair	Poor, unless EIFS
Concrete	Good	n/a	Good	Low	Good	Good	Poor
** = Depends on material, manufacturer and/or other factors*					*n/a = not applicable*		

Quiz 4

The _____ is the exterior wall covering or cladding of a house, considered the house's "skin."

- siding
- fastening
- paint
- barrier

Apart from providing the external appearance for the house, the primary function of cladding is to protect the structure from weather -- particularly, to shed _____.

- rainwater
- ice
- snow
- UV radiation

The joints in exterior siding may allow some water penetration, but an air gap and _____ behind the siding limit any penetration.

- water-resistant barrier
- insulation and vapor barrier
- plastic tape on the joints
- fasteners

Section 8: Wood Siding

8.0 Wood Siding

This section deals with the common details of wood siding that may be observed during an inspection of the exterior.
At the end of this section, you should be able to:

- list the different types and styles of wood siding; and
- identify common concerns related to wood siding.

8.1 Solid Wood or Lumber Siding

Solid wood or lumber siding may be the most common siding. It is attractive, durable, readily available, and relatively easy to install. Wood siding can be installed vertically, horizontally, diagonally, or in any combination.

Wood siding does not strengthen the structure, so corner bracing is needed. However, solid wood logs on a log home provide both siding and structural strength.

Maintenance

Maintenance of wood siding is often neglected. Your clients should understand the need to check the siding and maintain it. They should pay particular attention to the changes in direction and material, the ends of the wood pieces, and the penetrations.

Many siding problems are caused by improperly applied paint. Paint on siding may blister, peel, crack, fade or chalk. Some paint problems are caused by interior moisture that passes through the wall and lifts the paint.

Semi-transparent, oil-based stains can be applied to wood siding. Most beveled wood sidings have one rough-sawn side that absorbs paint and stain well. Unlike paint, stains do not lift (blister), peel, crack or chalk. Some woods can be allowed to weather without any stain applied. Vertical-grain, all-heartwood redwood and cedar are two ideal woods used for exterior siding.

Check for dense vegetation around the home. Vines and ivy that are close to or on the siding should be trimmed or removed. Vegetation holds moisture and water up against the siding, which can be detrimental to the siding's condition over time.

Installation

Siding should be installed tight enough to prevent problems related to water intrusion, but it should be loose enough to allow it to adequately dry after a rainstorm. Good wood siding has a good drying potential. Sunlight dries out wood siding, but it does not simply cause evaporation. The sun actually drives the water into the wood. It can drive moisture all the way through the wood siding. This is why it is important for the wood siding to have good drying potential, with air movement on the backside of the wood.

Natural wood siding should be installed over building paper regardless of the sheathing materials. Building paper is a water barrier rather than a moisture barrier. It is recommended to prevent water from entering the wall cavity. Foam

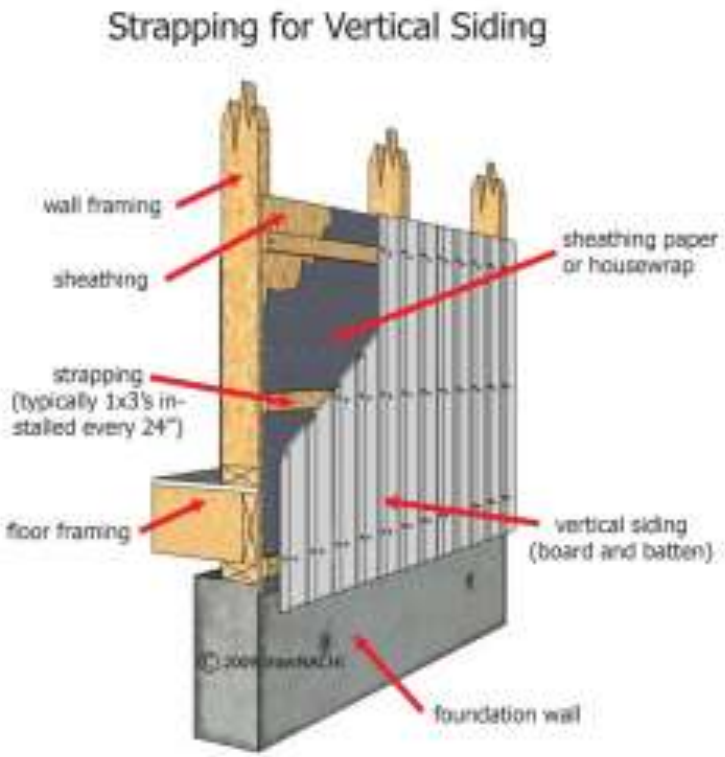
sheathing is a separate consideration. Caulk can be used where siding abuts openings and trim. Latex, latex-silicone blends, polyurethane, and polysulfide caulks generally perform satisfactorily. Caulks that are 100% silicone should not be used.

Nails

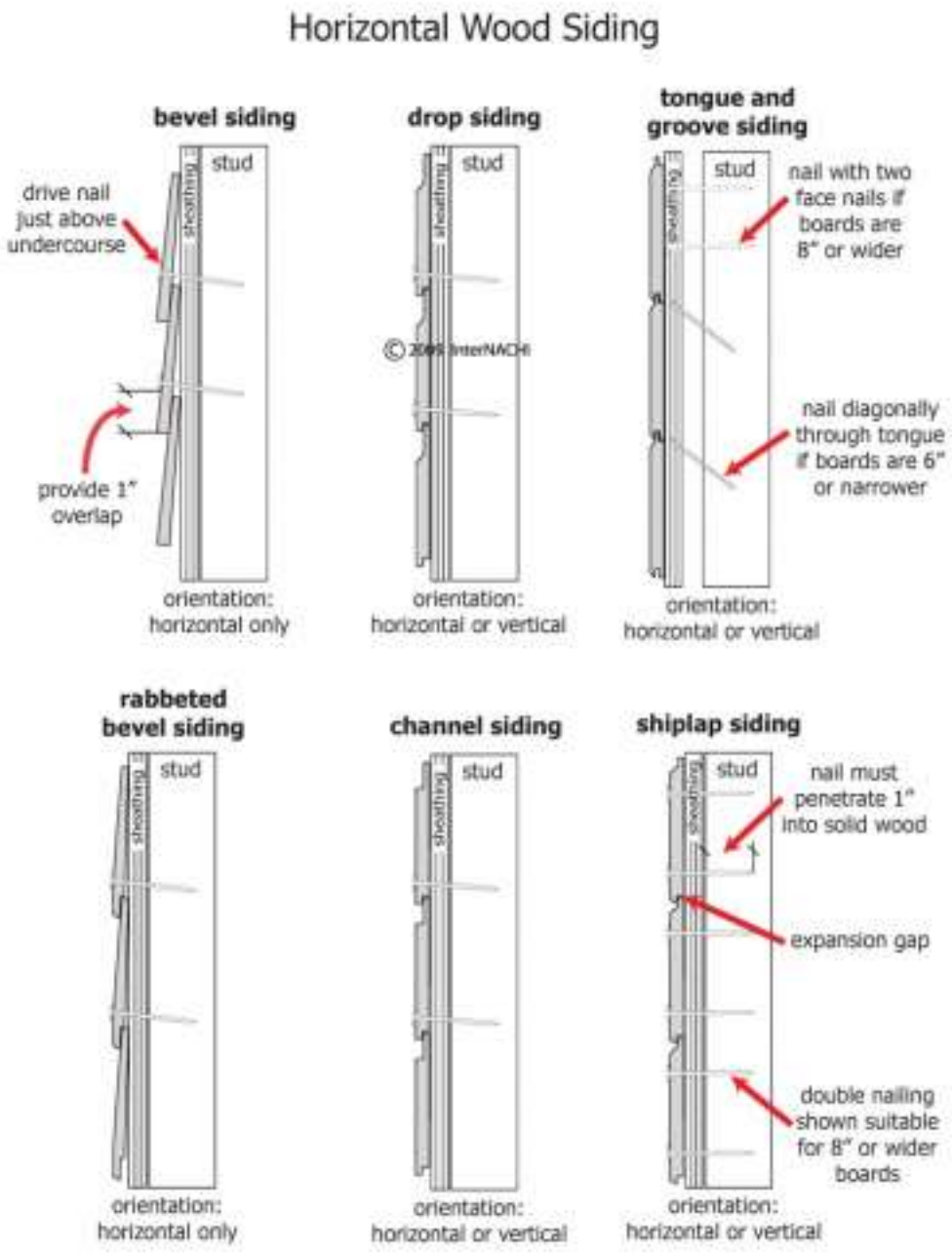
Correct nails and nailing practices are essential in the proper application of wood siding. In general, siding and box nails are used for face nailing, and casing nails are used for blind nailing. Nails must be corrosion-resistant and, preferably, rust-proof. Stainless steel is the best choice. Aluminum nails may be used. High tensile-strength aluminum is an economical choice. Hot-dipped galvanized nails are the least expensive, but may result in discoloration if precautions are not taken. Hot-dipped nails can rust and stain the wood over time. Other fasteners that are corrosion-resistant may perform satisfactorily. Some fasteners can cause black iron stains, which can be permanent. Nails can be exposed or hidden, depending on the siding type.

You may find that the siding is nailed into the studs, nailed into the solid wood strapping behind the siding, or just nailed into the sheathing.

Your job as an inspector is to report the condition of the wood siding. Look for damage, cupping, curling, cracking, splitting, and other conditions that may affect the performance of the siding.

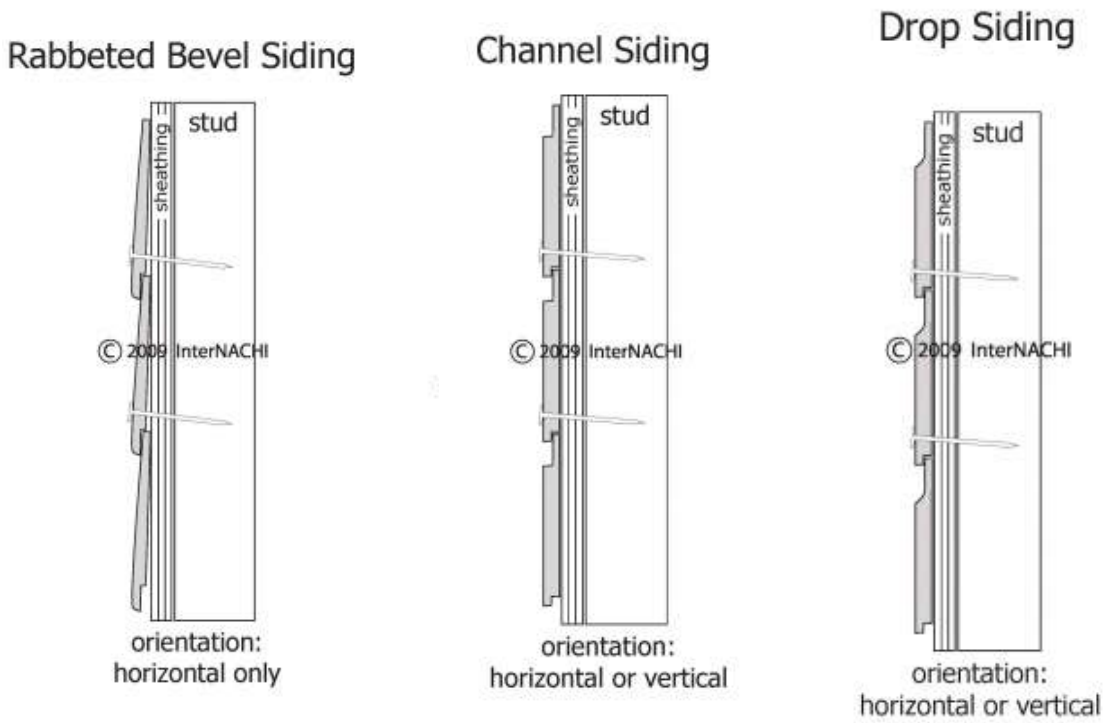


Examples of Solid Wood Siding



Common siding installation patterns include:

- beveled (rabbeted, feather-edge or clapboard);
- boards are thicker at the bottom than at the top;
- are installed horizontally;
- with a 1-inch overlap; and
- usually installed with one nail per stud.



Board and Batten

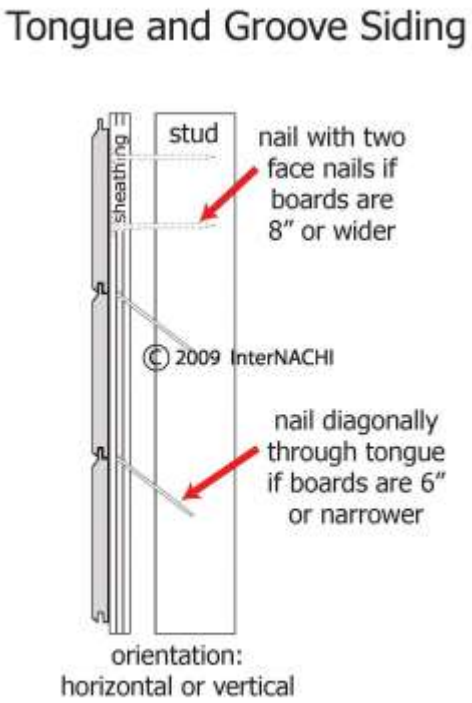
Characteristics of this installation include:

- vertical planks are the boards;
- narrow strips are the battens;
- battens cover the joint between the boards;
- installation is always vertical and never horizontal; and
- boards are spaced ½-inch apart.

Tongue and Groove

Characteristics of this installation include:

- siding can be horizontal or vertical;
- one nail per 6-inch wide boards;
- nails can be driven diagonally for 6-inch wide boards; and
- two nails per 8-inch or wider boards.

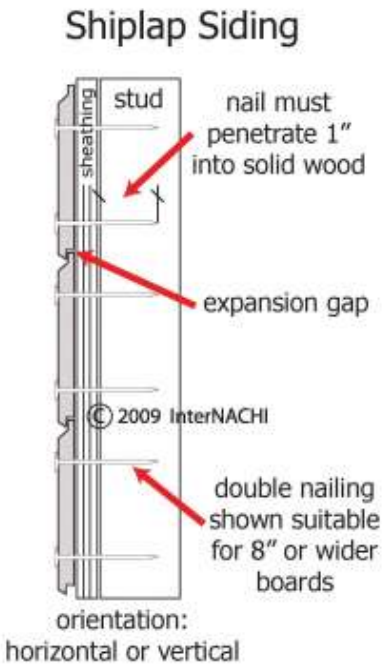


Shiplap

Characteristics of this installation include:

- looks like tongue and groove;
- can be horizontal or vertical;
- one nail per 6-inch wide boards; and
- two nails per 8-inch or wider boards.

In general, there should be more nails, and possibly an open gap, for boards 8 inches or wider.



There are many different species of wood used as wood siding. Cedar and redwood are used because of their natural decay-resistant resins. Shorter boards shrink less than longer ones. Wood boards that are 8 inches wide perform better than boards that are wider than 8 inches because narrow boards shrink less. Thicker boards perform better because they are less likely to cup, curve or split. Rough-textured wood holds finish and stains better than smooth boards. Wood with a low moisture content and few knots performs well. Inspectors are not required to identify the type of species and grade of wood siding during a home inspection.

Siding that Lasts

Wood siding material that is not suitable for exteriors, improperly installed, or improperly finished will often fail within a few years.

8.2 Plywood Siding

Plywood is a structural panel. Plywood siding is popular because it is less expensive to install than solid wood siding. It is readily available and easily installed. Plywood siding adds to the strength of a house's structure. Most plywood siding requires an exterior wood finish. Rough-surface plywood is ideal for paint and stain.

Plywood is made of thin sheets of wood veneer, or plies, that are glued together and arranged in layers. The grain of the layers is usually at 90° to adjacent layers, with the face layer's grain running the length of the panel. The alternating direction of the grain gives the sheet strength and stiffness. Plywood siding is more stable than solid wood siding with changes in moisture content. Plywood swells only slightly when saturated. Just like other wood, plywood can rot, deteriorate, delaminate and crack at the surface.

Exterior Floor Coverings

Houses near the ocean are almost always elevated. The space underneath the house is exposed to the elements unless it has been covered with exterior sheathing, siding, or another weather-resistant covering. Plywood is commonly used. Applying sheathing to the bottom of the floor structure can minimize corrosion of the framing fasteners and connections by limiting the salt spray and other coastal environmental factors. The exterior covering also protects any insulation installed on the floor structure. Exterior-grade sheathing should be used in this application, and stainless steel or hot-dipped, galvanized nails or screws should be used.

Installing rated roof sheathing at under-floor applications, and securing it to the floor framing using the same nailing schedule as that required for roof sheathing, will be an adequate method of securing the sheathing. To prevent moisture from being trapped, the floor-joist cavity created by the under-floor exterior sheathing should be vented.

8.3 Shingles and Shakes

Shingles and shakes are popular siding materials because they are durable and available in several wood species, lengths and types. Shingles and shakes do not add strength to the house structure. They require a good nailing base, such as wood or plywood sheathing. One of the most durable wood species for shingles and shakes is western red cedar.

Types

Wood shingles and shakes are usually western red cedar, white cedar, redwood or cypress; they have a natural resistance to wood rot. Pine may be used, but it is usually pressure-treated to resist rot. Western cedar has grades. The best grade is 100% heartwood. There is also 100% edge grain, and 100% clear of knots.

Installation

Wood shingles are usually installed for siding in two layers to create a double layer. Shakes may be taper-split, hand-split, re-sawn, straight-split or taper-sawn. Butt joints should be installed over studs or other support components.

Nails

Nails for wood shingles and wood shakes can be copper, stainless steel or hot-dipped, galvanized nails. Staples are sometimes used. You may see two nails or fasteners per shingle.

Not all of the nails will be going into the studs. Most will be going into the sheathing behind the siding. Building paper or housewrap is usually installed to protect the sheathing and provide a drainage plane.

Joints

Butt joints on vertical siding are usually cut at an angle or on a bevel. The upper board should overlap the lower board. Ideally, the joints on diagonal siding should

be cut so that the joints are both vertical and mitered. Joints in courses should be staggered, not lined up vertically connected.

Common Problems

The most common problems with wood shakes and shingles include:

- splitting;
- warping;
- finish problems; and
- rot.

Splits

Water can easily travel through splits in boards. There is open, exposed wood inside the split that can result in deterioration at that area. Split wood may be caused by shrinkage of the wood, poor nailing schedule, rusting nails, physical

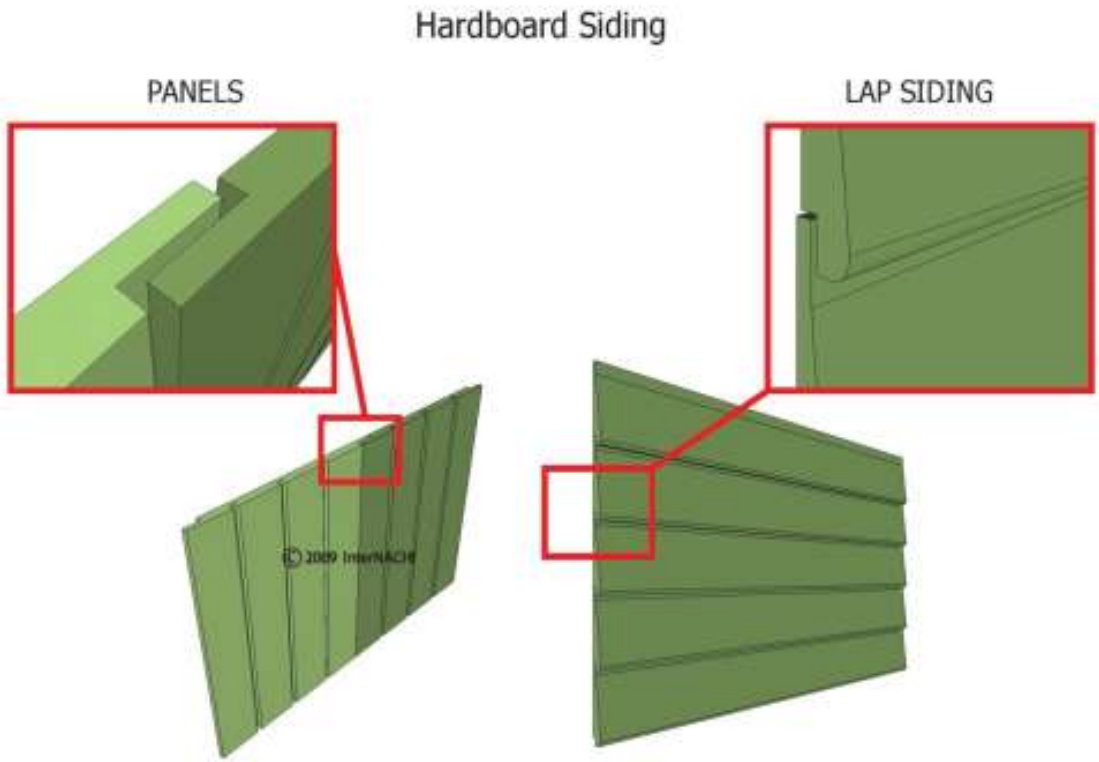
damage, butt ends too tight, or other conditions. Butt-ends should be spaced about 3/8-inch apart to allow for swelling.

Warping

Warping usually appears because one side of the wood is wet or moist and the other side is dry. Warped wood is not weather-tight and may allow water to penetrate the wall. Sometimes, a warped piece of siding can be carefully nailed back into place. Flattening the warped wood usually results in creating a crack. Look for screws or nails along a crack in a warped piece of wood siding, which may be an indication of an attempt to flatten it.

8.4 Hardboard

Hardboard is a popular type of fiberboard that is made from wood fibers designed with a specific density. It is compressed into a dense, wood fiberboard. Synthetic adhesives provide bonding between the fibers. Hardboard has a uniform composition and appearance. There are no grains, knots or natural deficiencies.



Hardboard siding is denser than wood siding. Hardboard does not delaminate, split or warp like natural, conventional wood boards. It does not expand or contract as much as natural wood does. It holds paint well. Hardboards are sometimes pre-finished.

Hardboard can be embossed and textured to appear like natural wood, plywood or stucco. It can be installed over sheathing or directly to the wall framing. Lapped hardboard does not strengthen the house structure.

Hardboard can be affected by moisture. It can rot. It swells more than natural wood when it is wet.

8.5 OSB Siding

OSB stands for oriented strand board. It is formed of wood wafers mixed with a waterproof resin binder. It is then laid flat and oriented. Heat is applied, and wafers are formed into panels.

Unlike general waferboard, the wafers in an OSB panel are oriented so that they align parallel with the length of the panel, giving it significant strength.

If exposed to the elements, OSB will absorb moisture quickly and swell, and the wafers and layers will delaminate. The edges of OSB are particularly susceptible to moisture and physical damage.

8.6 Particleboard Siding

Particleboard is available as overlaid particleboard siding and as waferboard.

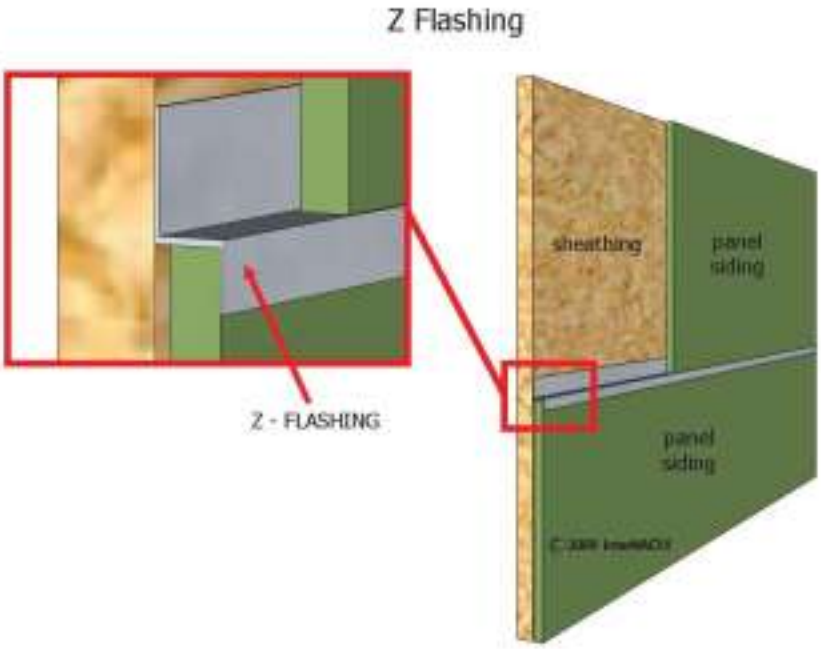
Overlaid particleboard siding has a particleboard core, overlaid on both sides, with a resin-impregnated fiber sheet. It has a smooth surface.

Waferboard is particleboard with large wood flakes left exposed. It does not absorb paint or stain well and should not be used as exterior siding. Waferboard is typically used for sheathing under the siding. Waferboard is made of wafers that are not oriented the way OSB is.

8.7 Considerations

Buckling and Cracking

Buckling and cracking are commonly found with hardboard. When hardboard is used as siding, the wood must be allowed to expand and contract along the length of the board. Buckling and cracking of wood siding materials can be caused by nailing too tightly, or because adjacent boards are butted together too tightly. A space of 1/16-inch to 1/8-inch should exist in between the edges of adjacent sheets of OSB or plywood. The space allows room for expansion and contraction. Hardboard siding should have a space of 3/16-inch in between the pieces.



Inspection Tips for Z-Flashing

Look for Z-flashing at horizontal joints between hardboard and plywood siding panels. The metal Z-flashing should extend up behind the upper piece, horizontally across the joint, and down over the lower piece. Look for this type of flashing at critical areas.

Expansion and Contraction of Wood

One concept to understand about wood siding is that wood moves. If you were to inspect a piece of 2x4 under a microscope, you would see a bunch of tiny parallel tubes. When that 2x4 was part of a tree, those tubes or passageways were used to move nutrients through the tree. Now that it is a 2x4, the tubes tend to expand and contract in relation to the temperature and humidity.

Wood tends to expand and contract in one particular direction. The significant

expansion and contraction are across the grain – not with the grain. Wood movement parallel with the grain is hardly measurable, whereas expansion and contraction across the grain are significant.

The expansion and contraction vary between different wood species. They can vary even from board to board. A general rule of thumb is that a board can move up to 1/16-inch per foot across the grain.

Manufactured panels, such as plywood and particleboard, include so much glue that expansion and contraction are virtually nonexistent.

8.8 Finish Problems

Paint and stain are considered to be necessary by most people who want to extend the life of their wood siding. Paint and stain can give the house a desirable appearance and protection against weathering. On an inspection, you may find that wood siding has paint or stain that is in poor condition. The siding on the south side will usually weather and deteriorate before the other sides of the house because of its exposure to the sun.

Paint

Paint is a surface finish of a liquid or mastic composition that contains pigments. After application in a thin layer to a substrate, such as wood siding, it is converted to an opaque, solid film.

Pigments

Pigments are granular solids incorporated into the paint liquid that give it color, durability and texture. Some paints contain dyes instead of or in combination with pigments. Pigments are either synthetic or natural. Synthetic pigments include engineered molecules and synthetic silica. Natural pigments include clay, mica, calcium carbonate, and silica. Pigments can make the paint opaque and, as a result, protect the substrate from weather and ultraviolet light.

Lead

Some pigments are toxic, such as the lead pigments that are used in lead paint. Lead was banned from being manufactured for residential use in 1978 by the U.S. Consumer Product Safety Commission. Paint manufacturers replaced white lead pigments with the less toxic substitute, titanium white (titanium dioxide). You can learn more about lead paint, including remediation techniques, in InterNACHI's Lead Safety for Renovation, Repair and Painting course.

Binder

The film-forming component of paint is called the binder. The binder binds the pigments together, and strongly influences such properties as gloss potential, exterior durability, flexibility and toughness. A binder can be categorized according to its drying or curing mechanism.

Drying

Drying and curing are two different things. Drying refers to evaporation of a solvent. Curing refers to polymerization of a binder. There are paints that only dry, and there are those that only cure. There are also those that dry and then cure. Paints dry when the solvent evaporates, and a solid film forms when the solvent evaporates.

Latex

Latex paints cure by a process called coalescence, where first the water and then the solvent evaporate and draw together, softening the latex binder particles and fusing them together into irreversibly bound networked structures.

Paint or Stain in Poor Condition

Paint or stain may be in poor condition for a number of reasons, including:

- age;
- poor quality;
- UV deterioration;
- physical damage;
- excess moisture;
- weathering; and/or
- poor application practices.

Inspection Tips for Paint

Look for cracking, peeling, checking and blistering paint conditions. Poor paint

conditions could be the result of many things, including moisture problems. Peeling paint is often caused by poor preparation of the surface prior to painting. Cracking may be caused by old age, and the expansion and contraction of the wood. Blistering could be caused by moisture. Try to note the general condition of the paint surface of the siding as a whole, and then move in closer and report any smaller areas that are significantly deteriorated.

8.9 Chalking

"Chalking" refers to the white, powdery film on the surface of paint. As the paint weathers and the binder slowly degrades by ultraviolet radiation and moisture, chalking can occur.

Over time, the binder's hold on the pigment is released. After years of being hit by sunlight, paint simply starts to wear or erode away. This exposes the pigments beneath, and since they are no longer bound into the paint film, they are easily wiped off. This result is chalking. Old paint is likely to be chalky. The chalk is the powder that is deposited on your finger when you rub it over old, chalky paint.

Chalk can run down the wall's surface beneath and cause cosmetic problems with the wall's appearance.

Chalk can be considered to be in the same category as dust and dirt. Chalk can be removed. Once removed, the surface can be re-painted. The surface can be simply dampened with fresh water and scrubbed with a bristled brush or broom.

8.10 Rot

When the moisture content of wood is above 20%, and the external temperatures are between 40° F and 115° F, wood rot may be found. If you find rot, look for the source of the moisture. The source can be from a roof leak, gutter leak, openings or gaps in joints, condensation, air movement, wood installed close to grade or in contact with soil, inadequate drying, or other conditions. Oftentimes, the source of water penetration into a wall comes from the poor building practices around the windows and doors or wall attachments, such as light fixtures. Wood siding is

susceptible to rot at the ends of the boards. Cut boards should be sealed or painted in order to resist wood rot.

Outside corners are good places to look for wood rot because imperfections in the corner joints and connections may expose the end grains to moisture. Mitered corner joints are not the best practice. Outside corner boards and metal outside corner details perform better than mitered joints.

Inspection Tips for Rot

Inspect for rot by pressing the wood with your hand or finger. Tap on wood with the back of your screwdriver. A non-invasive moisture meter can be used to confirm suspicious conditions. Probing the wood may confirm whether it is deteriorated, wet or rotting. Look closely at wood near the ground surface. Check the end grains and joints. Check the siding for adequate clearance from the roof surface.

Section 9: Aluminum and Steel Siding

Aluminum and Steel Siding

This section deals with the common details of aluminum and steel siding that may be observed during an inspection of the exterior.
At the end of this section, you should be able to describe the common concerns with both aluminum and steel siding.

Aluminum

Aluminum is among the most common siding materials. Aluminum siding can be made to look like wood, including vertical shingle and shake styles. Aluminum expands and contracts with temperature changes, so installation by a skilled installer is important. Aluminum does not add to structural strength. It is installed over sheathing.

Aluminum siding dents easily. To protect against dents, many manufacturers offer a thin backerboard of insulation that fits behind each panel. The insulation can reduce noise and slightly increase the insulation value of the siding. If scratched, the exposed aluminum will not rust. Scratches can be touched up with a special paint or material.

Aluminum siding can conduct electricity, and grounding may be an installation requirement.

Repainting aluminum is similar to repainting a car, requiring preparation, appropriate paint selection, and proper application.

Steel

Steel siding is less common than aluminum. The most popular styles of steel siding look like smooth or textured bevel-wood siding. Many colors and styles are available. The installation of steel siding requires special skill and tools.

Steel siding is resistant to dents, but if the finish becomes scratched or chipped, repair will be needed to prevent rust from developing. Steel siding can be repainted.

Steel siding can conduct electricity, and grounding may be an installation requirement.

Grounding Metal Siding

Some jurisdictions require that metal siding be grounded. Grounding the metal siding is a safety measure. Check with your local authority having jurisdiction (AHJ) as to whether grounding the metal siding is a requirement.

Section 10: Vinyl Siding

Vinyl Siding

This section deals with the common details of vinyl siding that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how vinyl siding functions; and
- list the common concerns related to vinyl siding.

Vinyl siding is the exterior cladding of choice for homeowners, remodeling contractors and builders. Compared to other siding products, vinyl is attractive, durable, easy to maintain, and cost-effective.

Vinyl siding is made of extruded polyvinyl chloride (PVC). The color permeates through the material. Scratches do not need to be repainted. If the vinyl is scratched, the scratch is the same color. The color does not peel or chip off the surface.

Vinyl will not fade, rust or dent easily. It comes in a wide variety of colors and styles. Vinyl siding is manufactured to resemble wood, brick and stone. Vinyl is flexible except in extremely cold weather, when it becomes brittle. Vinyl siding does not support combustion, but may soften and distort under high temperatures.

Maintaining vinyl siding is easy. Maintenance consists of an occasional spray and wash with a hose. Mild detergents can be used.

Vinyl siding has always been designed as an exterior cladding, not a water-resistant barrier.
Vinyl siding is designed to allow the material underneath it to breathe; therefore, it is not a
watertight covering. Vinyl siding provides a supplemental rainscreen that enhances the water-resistive barrier system by reducing the amount of water that reaches the underlying water-resistant barrier.

Vinyl siding is made from organic materials and will melt or burn when exposed to a source of flame or heat, such as grills. Combustible materials, such as dry leaves, mulch and trash, should be kept away from vinyl siding.

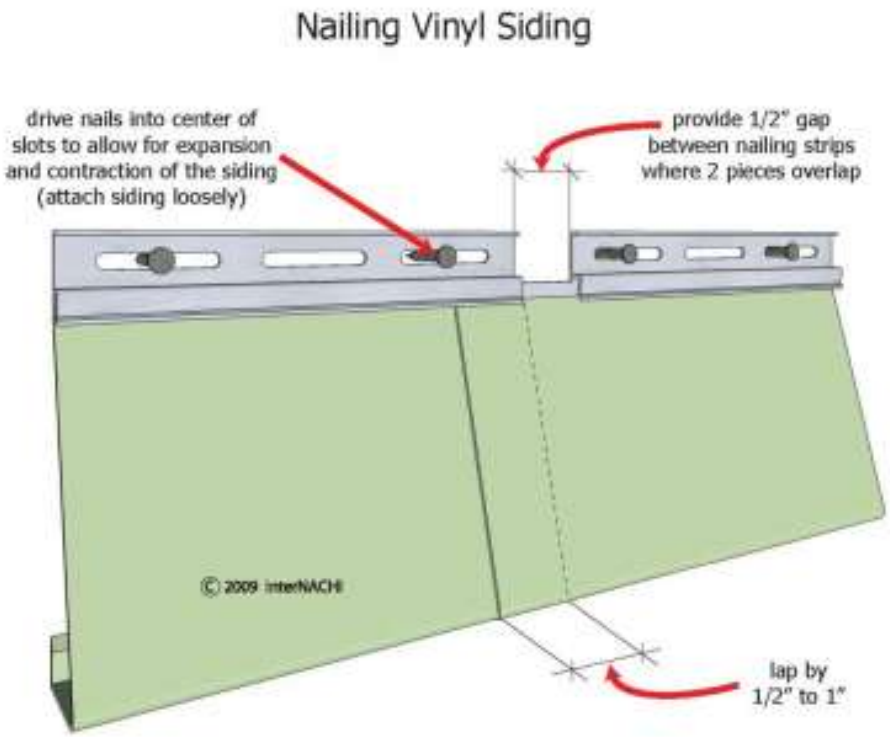
Inspection Tips for Vinyl Siding

- Installed panels and accessories must move freely from side to side.
- Fasteners should be installed in the center of the nailing slot.
- Fasteners should penetrate a minimum of 3/4-inch (19mm) into a nailable surface. The nailable surface could be substantial sheathing or furring strips.
- The head of the fastener should not be tightly driven against the siding nail hem. There should be approximately 1/32-inch of clearance (0.8mm), about the thickness of a dime, between the fastener head and the siding panel.
- Fasteners that are not driven straight and level may cause distortion and buckling of the panel.
- A minimum of 1/4-inch (6.4mm) clearance should be left at all openings and stops to allow for normal expansion and contraction.
- Caulk should not be installed where the panels meet the receiver of inside corners, outside corners, or J-trim. Caulk should not be applied at the overlap joints.

- Vinyl should not be face-nailed or stapled through the siding. Face-nailing can result in ripples in the siding.
- Lap joints should be staggered. Two joints should not line up vertically.
- Building paper or housewrap should be installed behind vinyl siding. Wind-driven rain can easily get behind vinyl siding. Horizontal vinyl siding has drainage holes or slots in the bottom to allow water that gets behind the siding to drain.

Vinyl Siding Moves

Vinyl siding expands and contracts constantly in relation to temperature. Think of vinyl siding as loosely floating on the wall's surface.



Surface-mounted fixtures, such as exterior lights, should not be mounted directly

onto the vinyl siding. Fixtures such as lights, electric meters, window shutters and hose bibs should be mounted on mounting blocks. If a fixture is installed on the siding, the fasteners that go through the siding will restrict the siding's movement when it expands and contracts.

Fasteners for Vinyl Siding

Aluminum, galvanized steel, or other corrosion-resistant nails, staples or screws can be used when installing vinyl siding. Aluminum trim pieces require aluminum or stainless steel fasteners. All fasteners must be able to penetrate a minimum of 3/4-inch (19mm) into framing or furring. Review your local building codes for variations that may apply to specific geographic areas.

Nails should be 5/16-inch (7.9mm) minimum in diameter. Shanks should be 1/8-inch (3.2mm) in diameter. Screw fasteners can be used if the screws do not restrict the normal expansion and contraction movements of the vinyl siding panel on the wall. Screws must be centered in the slot with approximately 1/32-inch (0.8mm) space between the screw head and the vinyl. Screws must be able to penetrate not less than 3/4-inch (19mm) into framing or furring of corrosion-resistant, self-tapping sheet metal type.

Vinyl siding should terminate in a J-molding around the windows and doors. J-molding is not flashing. It simply holds the ends of the siding pieces in place and creates a smooth termination edge.

Quiz 5

T/F: Wood siding can be installed vertically, horizontally, diagonally, or in any combination.

- True
- False

T/F: Natural wood siding should be installed over building paper, regardless of the sheathing materials.

- True
- False

Correct _____ and _____ practices are essential in the proper application of wood siding.

- nails..... nailing
- nails..... painting

- screws..... pounding
- fasteners..... caulking

T/F: A common wood siding pattern is a 1-inch overlap.

- True
- False

_____ and redwood are used because of their natural decay-resistant resins.

- Cedar
- Pine
- Maple
- Spruce

T/F: Wood shingles and shakes do not add strength to the house's structure.

- True
- False

T/F: Ideally, joints in courses of wood siding should be staggered.

- True
- False

T/F: Hardboard will delaminate, split and warp.

- False
- True

If exposed to the elements, _____ will absorb moisture quickly, making it swell, so it is particularly susceptible to moisture and physical damage.

- OSB
- waferboard
- vinyl

One concept to understand about wood siding is that wood _____.

- does all these things
- moves
- expands
- contracts

The manufacture of lead paint for residential use was banned in _____ by the U.S. Consumer Product Safety Commission.

- 1978
- 1962
- 1990
- 2010

_____ refers to the formation of a white, powdery film on the surface of paint, which is produced as the binder slowly degrades from exposure to ultraviolet radiation and moisture.

- Chalking
- Whitening
- Powderizing
- Aluminizing

Wood rot may be found when the wood's moisture content is above ____.

- 20%
- 60%
- 40%
- 30%

T/F: Aluminum expands and contracts with temperature changes.

- True
- False

Aluminum siding _____ easily, so many manufacturers offer a thin backerboard of insulation that fits behind each panel.

- dents
- burns
- absorbs water
- warps

Maintaining _____ siding is easy.

- vinyl
- wood

There should be a clearance of approximately 1/32-inch between the fastener head and the _____ siding panel.

- vinyl
- wood
- OSB
- hardboard

- brick

T/F: Building paper or housewrap should not be installed behind vinyl siding.

- False
- True

Section 11: Structural Insulated Panels

SIPs

This section deals with the common details of structural insulated panels that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how structural insulated panel siding functions; and
- list the common concerns related to the siding.

Structural insulated panels (SIPs) are high-performance building panels used in floors, walls and roofs for residential and light commercial buildings. SIPs are manufactured under factory-controlled conditions. The panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB). Other skin material can be used for specific purposes.

These panels are designed to be part of the structural support members of the outer walls. They are used in post-and-beam construction, and can form a complete wall system with an exterior wall covering, insulation, and an interior wall surface.

The result is a building system that is extremely strong, energy-efficient and cost-effective. Building with SIPs saves time, money and labor.

Like an I-Beam

SIPs are structurally self-sufficient. The structural characteristics of SIPs are similar to that of a steel I-beam. The OSB skins act as the flange of the I-beam, while the rigid foam core provides the web. This design is extremely strong and eliminates the need for additional framing.

In roof applications, SIPs rely on beams and purlins for support. SIPs can span long distances, allowing a minimal amount of structural supports to be used.

Similar to Conventional Framing

The majority of construction with SIPs is very similar to conventional framing. SIPs accept dimensional lumber and are fastened together using staples, nails or screws. Proper sealing is especially crucial in an SIP structure. All joints need to be sealed with specially designed SIP sealing mastic or low-expanding foam sealant, and/or SIP tape. Voids between panels and unused electrical chases need to be filled with low-expanding foam.

Modifications

On-site modification can be easily done. A few additional SIP-specific tools are needed. Panels can be cut using a beam saw or a beam-cutting attachment on a circular saw. The foam core can then be recessed for splines or dimensional lumber using a hot-wire foam scoop or specialized angle-grinder attachment to recess the core.

Air Barriers

Air barriers or vapor barriers are not required in SIP buildings because properly sealed SIPs create a code-compliant air barrier with a permeability rating of less than 1 perm. In addition, the foam core of SIPs is solid and continuous throughout the wall, eliminating the convection and condensation issues that can occur in cavity walls.

Mold Prevention

An airtight SIP building envelope forms the basis of a successful mold-control strategy. The extremely low levels of air infiltration in SIP buildings allow for incoming air to be provided in controlled amounts by air-handling equipment. In addition to creating an airtight structure, SIPs are solid and free of any cavities in the wall where moisture can condense and cause unseen mold growth.

Siding Attachment

Builders should consult the siding manufacturer's installation instructions for how to attach their product to SIPs. Because SIPs use very little solid lumber, an increased fastener schedule is typically required when attaching exterior cladding.

If the siding manufacturer does not offer recommendations for attaching their product to SIPs, a licensed architect or engineer can calculate the appropriate fastener frequency by obtaining fastener pull-out capacities from the SIP manufacturer.

It is also important that proper moisture management procedures be followed when applying any type of cladding to SIPs. With the exception of metal and vinyl siding, all claddings should be installed with a drainage gap between the cladding as well as a weather-resistant barrier in climates that average more than 20 inches of annual rainfall.

Quiz 6

T/F: SIP panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of OSB.

- True
- False

T/F: SIPs are self-sealing, so they don't require any additional sealing at the joints.

- False
- True

T/F: An air or vapor barrier is not required in SIP buildings because properly sealed SIPs create a code-compliant air barrier with a permeability rating of less than 1 perm.

- True
- False

Section 12: Brick, Stone & Stucco

12.1 Brick

Clay brick has been used for centuries as a siding material.

Brick is durable.

It is attractive with its many types, colors and textures.

Brick houses are known to be quiet.

Brick does not burn, rot, support termites, suffer hail damage, or conduct electricity.

Brick is structurally strong.

A common practice is to use brick as a facing material. A full-size brick is commonly laid in front of either a concrete, concrete block or framed wall.

Brick is heavy and requires support with a footing.

Metal ties are used to connect the brick to the house framing, or the brick may be connected to a concrete or block wall with cement mortar.

An air gap between the brick and the framing provides some insulation value.

Brick siding needs some maintenance, such as maintaining the mortar joints, and preventing moisture from entering the wall.

Brick can last the lifetime of the house.

12.2 Stone

Stone has been used for centuries as an exterior covering material. Stone is durable. It comes in many sizes, colors and patterns.

Manufactured stone is a combination of cement, light aggregates, and colored oxides. It can be difficult to distinguish manufactured stone from real, natural stone.

12.3 Stucco and EIFS

Describe and Identify

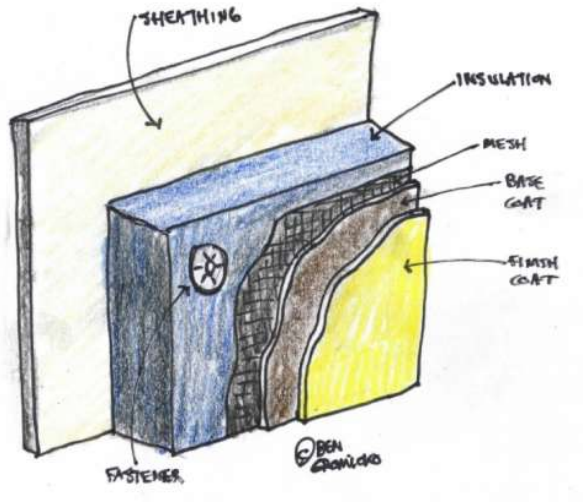
The InterNACHI Residential Standards of Practice state that an inspection report shall describe and identify, in written format, the inspected systems, structures and components of the dwelling, and shall identify material defects observed. The difficulty is in the identification of the exterior covering material.

When the siding appears to be stucco, it may not be enough for many inspectors to simply identify the covering as "stucco." You may decide that it is in the best interests of your client to know what type (or types) of stucco is installed on the house, and to correctly identify whether the cladding is EIFS. With professional training, a home inspector should be able to identify the type of stucco that is installed on the house, as well as identify common concerns and defects related to the material, and then communicate his/her findings in an inspection report.

This section does not go into exhaustive detail about performing a stucco and EIFS inspection, so you should consider taking a professional training course, such as InterNACHI's How to Inspect Stucco and EIFS online video course. This course will teach you about the best non-invasive, visual-only inspection techniques used to inspect stucco and EIFS, as required by the InterNACHI Residential Standards of Practice.

To be able to identify the stucco system, you must understand the system's components. You should understand the basic components of the most common stucco systems. Some homes have multiple systems installed on them. At times, it may not be possible to identify the system. Occasionally, you will find that the cladding is not a standard system but, rather, a combination of components or systems.

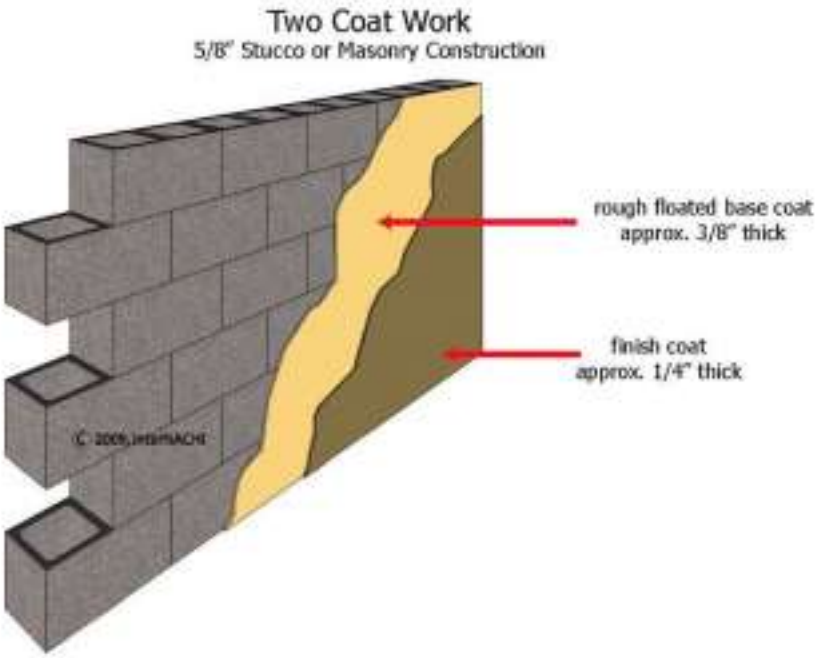
General



Stucco is used as an exterior covering or coating on residential buildings, and is common in many parts of the U.S. Stucco is durable. Traditional stucco is made of lime, sand and water. Modern stucco is made of Portland cement, sand and water. Lime can be added to decrease the permeability and increase the workability of modern stucco. Sometimes, proprietary

additives, such as synthetic acrylics and glass fibers, are added to improve the stucco's strength and flexibility.

Modern stucco can be applied as one base layer and a finish layer, which is thinner and faster to apply, compared to the traditional application of three-coat stucco. Stucco is applied wet and hardens to a very dense solid. It is used as a coating for walls and ceilings and for decoration. Stucco may be used to cover concrete, block and brick.

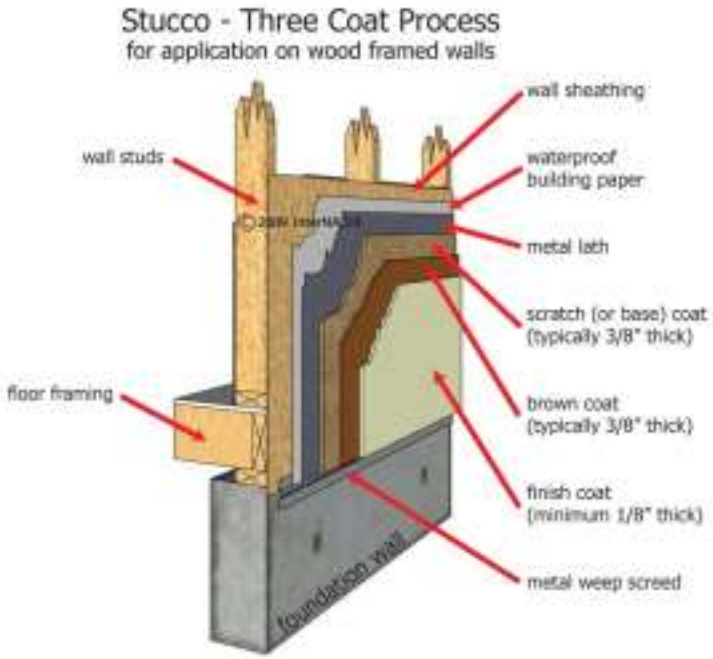


Components

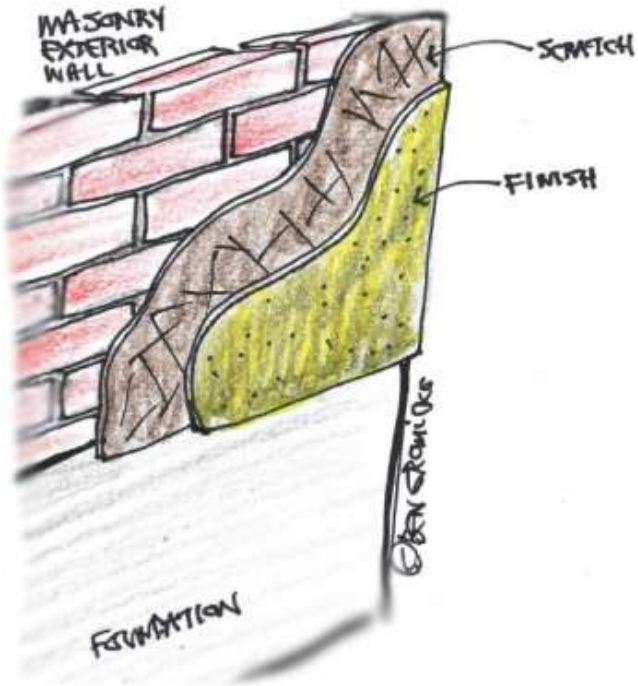
There are several components that should be inspected during the identification and description of the stucco/EIFS siding material, including the:

- exterior wall cladding;
- flashings;
- trim;
- doors and windows;
- deck and balcony attachments and flashings;
- eaves, soffits and fascias; and
- grading and surface drainage.

Coats



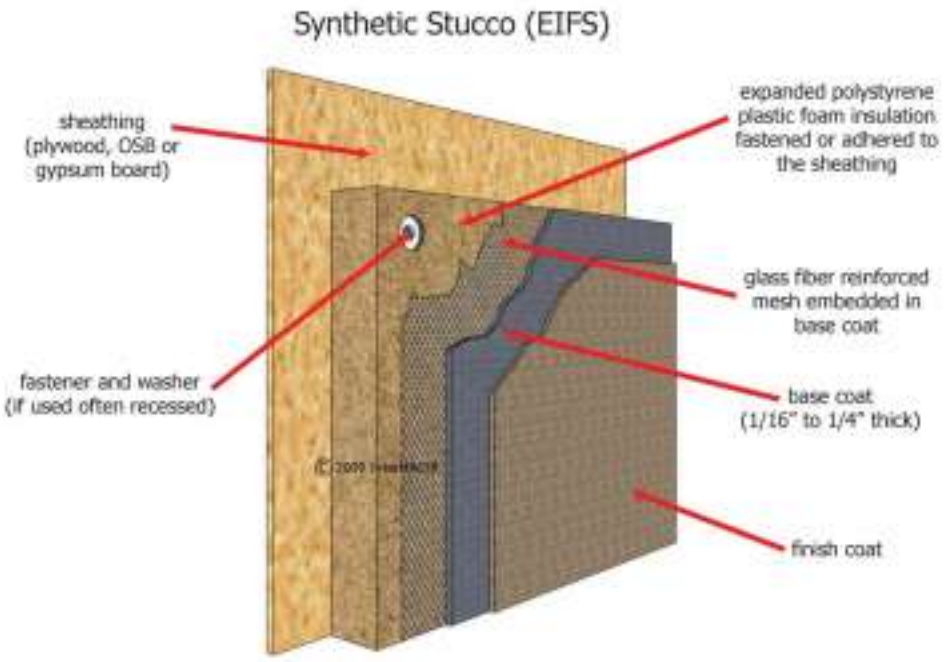
Stucco is typically applied in coats called the base, scratch, brown and finish coats. For some exterior wall applications, lath, mesh or netting is installed with the stucco. On some stucco applications, there may be a weather-resistant barrier installed behind the stucco. This barrier is typically asphalt-impregnated felt paper. It protects the framing (whether wood framing or metal) from moisture that may pass through the stucco covering. The barrier is referred to as a WRB (weather-resistant barrier) or MRB (moisture-resistant barrier).



The WRB or MRB is usually an asphalt-saturated paper, but there is a variety of manufactured plastic-based sheets known as building wraps and stucco wraps. The properties of the weather barrier should protect the framing from rain and moisture and, at the same time, allow the free passage

of any water vapor generated inside the building so it can escape through the wall.

There is a wide variety of stucco accessories, such as weep screeds, control and expansion joints, corner-aids, and architectural "plant-on" details that can be incorporated into the stucco application. Wire lath is used to give the plaster something to attach to and to add strength.



Stucco is valued as an exterior covering material for its attractiveness, versatility and durability. Portland cement can last indefinitely without requiring maintenance. Stucco is versatile. It can be directly applied to brick and concrete, or applied to a lath (paper or wire mesh) over wood frame or other material.

Weep Screeds

A corrosion-resistant weep screed or plastic weep screed should be provided at or below the foundation plate line on the exterior stud walls. The weep screed should

be placed a minimum of 4 inches above the earth, or 2 inches above paved areas, and should be of a type that will allow trapped water to drain to the exterior of the building.

Inspection Tips for Weep Screeds

If you cannot easily access, reach or see the bottom of the wall and the weep screed, then the installer of the stucco probably had a difficult time down there, as well. If it's difficult to reach, there may be a problem there. Wear knee pads while inspecting the stucco at ground level. Use a mirror with an extension arm to check the bottom wall's termination for the proper installation of weep screeds.

Polystyrene

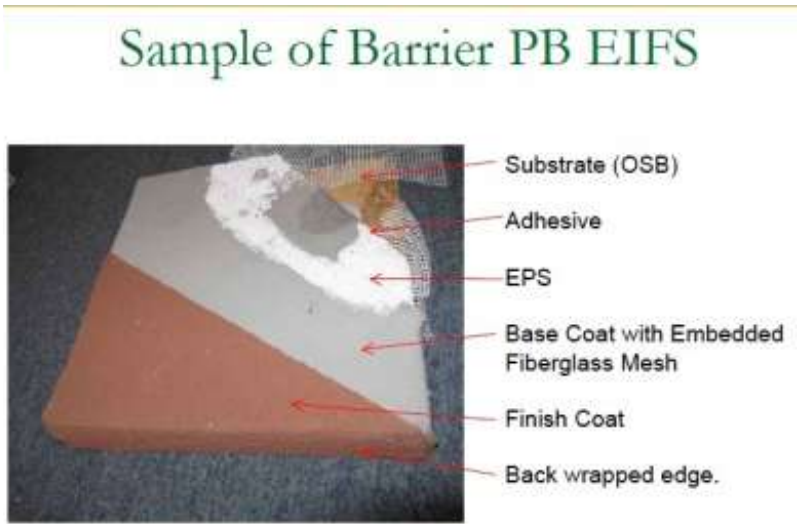
Polystyrene is a polymer, and one of the most widely used plastics. Solid polystyrene is used, for example, in disposable cutlery, plastic models, CD and DVD cases, and smoke detector housings. Products made from foamed polystyrene are nearly ubiquitous, for example packing materials, insulation, and foam drink cups.

EPS

Expanded polystyrene (EPS) is a rigid and tough, closed-cell foam. It is usually white and made of pre-expanded polystyrene beads. Familiar uses include molded sheets for building insulation and packing material ("peanuts") for cushioning fragile items inside boxes.

XPS

Extruded polystyrene foam (XPS) is a closed-cell foam. Styrofoam is a trademarked name for XPS; however, it is often also used in the United States as a generic name for all polystyrene foams.



Barrier or Face-Seal PB-EIFS

This is the most common type of EIFS. "PB" stands for polymer-based. The barrier of the system's design prevents water from getting behind the exterior surface.

Components of a barrier include:

- EPS insulation adhesively or mechanically attached to a substrate;
- polymer-based base coat with embedded fiberglass mesh; and
- an acrylic finish coat.

Things to look for to identify a barrier PB-EIFS-clad home:

- the presence of EPS foam insulation (by itself, EPS does not mean the cladding is EIFS);
- the presence of fiberglass mesh;
- thin (about 1/16-inch) lamina of base coat, mesh and finish coat;
- the wall surface gives slightly to hand pressure;
- there are typically no accessories, although PVC starter tracks or casing beads are allowed;
- it sounds hollow when tapped; and
- adhesive is used to attach it to the substrate (OSB, plywood, etc.).

The base coat for PB-EIFS:

- is trowel-applied;
- has a weather-resistant layer;
- has a fiberglass mesh that provides its impact and crack resistance;
- encapsulates the mesh with a base coat; and
- is applied in a thickness of 1/16-inch.

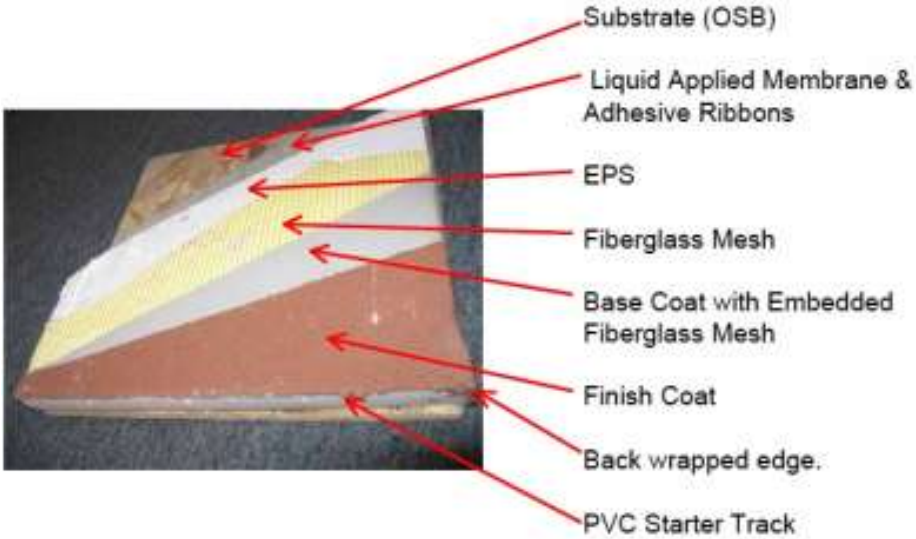
Moisture-Drainage MD-EIFS

The basic installation appears very similar to barrier PB-EIFS, with one additional component. A moisture barrier and drainage plane are first placed over the moisture-sensitive substrates. PVC accessories are permitted, but not required. Most systems have a weep screed (PVC starter track with weep holes), but not all systems. Historically, they were mechanically fastened; thus, they flex more than PB-EIFS. However, the most advanced systems are now adhesively attached. Each system is proprietary, so there are many variations.

An MD-EIFS-clad home can be identified by:

- the moisture barrier over the substrate;
- the EPS foam insulation (by itself, EPS does not mean the cladding is EIFS);
- the fiberglass mesh;
- the thin lamina of about 1/16-inch;
- the wall surface giving slightly to hand pressure;
- the presence of optional accessories, such as PVC starter tracks or other drainage provisions at the bottom of the wall;
- the hollow sound it makes when tapped; and
- its mechanical attachment to the substrate (OSB, plywood, etc.), although new systems are adhesively attached to liquid-applied membranes.

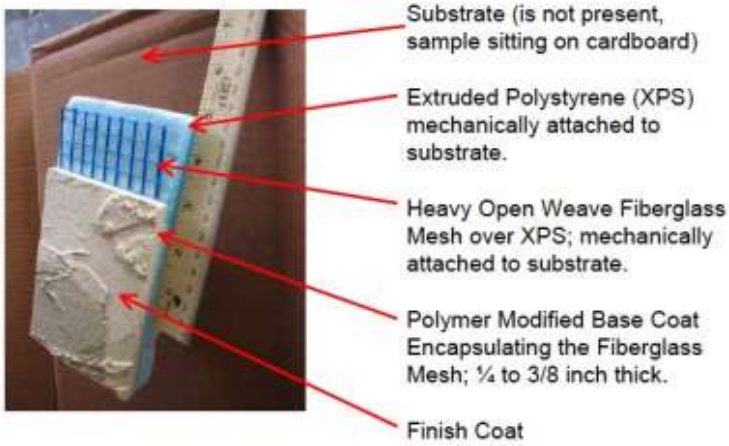
MD-EIFS



Polymer Modified PM – EIFS

Polymer Modified or PM-EIFS

PM systems were popular in some locations around the U.S., but were not extensively used.



PM components include:

- extruded polystyrene (XPS), mechanically attached;
- heavy fiberglass mesh, mechanically attached;
- thicker basecoat of ¼-inch to 3/8-inch;
- control and expansion joints (limit 144 sq. ft.); and
- plastic or metal trim accessories.

Things to look for to identify a PM-EIFS-clad home:

- the presence of XPS foam insulation;
- an exposed heavy, open-weave fiberglass mesh;
- a thick lamina of ¼-inch to 3/8-inch;
- the wall surface is hard and firm;
- the presence of PVC or metal accessories;
- it sounds solid when tapped;
- it is mechanically attached to the substrate (OSB, plywood, etc.); and
- there is typically no drainage plane or moisture-resistive barrier.

Modern Polyisocyanurate or PI-EIFS

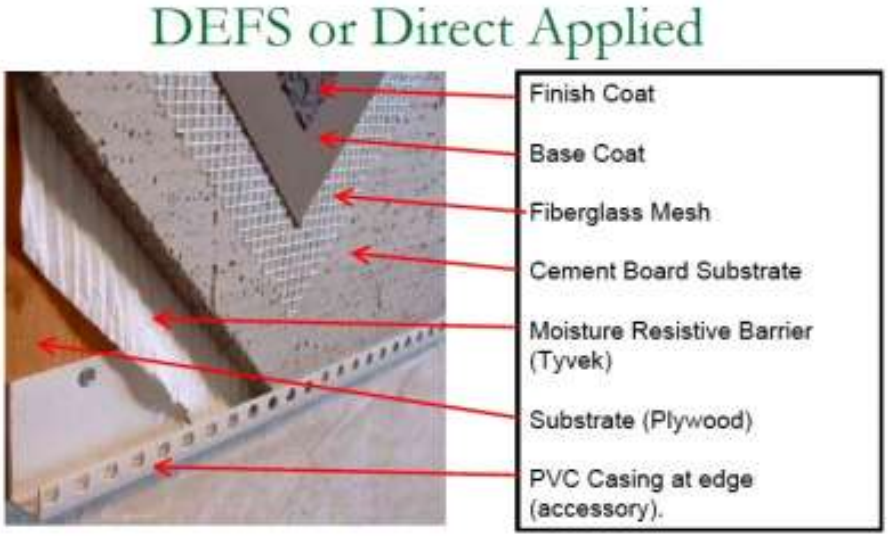
These systems perform much better but have lost the economy that they originally had.

Most current PI systems require:

- a substrate;
- a moisture-resistant barrier;
- the joints must be base-coated and meshed; and
- the PI insulation board must be fully meshed and base-coated.

Direct-Applied Exterior Finish System or DA or DEFS

Historically, DEFS had lamina directly applied to an approved substrate, such as DensGlass® (a product of Georgia-Pacific) or cement board (not insulation board).



Current specifications call for cement board in all exposed wall areas, while DensGlass® or its equivalent is approved in protected areas. Originally, mesh was required only at joints in approved substrate. Now, all manufacturers require that the mesh cover the entire wall surface. DEFS uses system accessories. Each system is proprietary, so there are many variations.

Traditional or Three-Coat Stucco

Basic components and characteristics include:

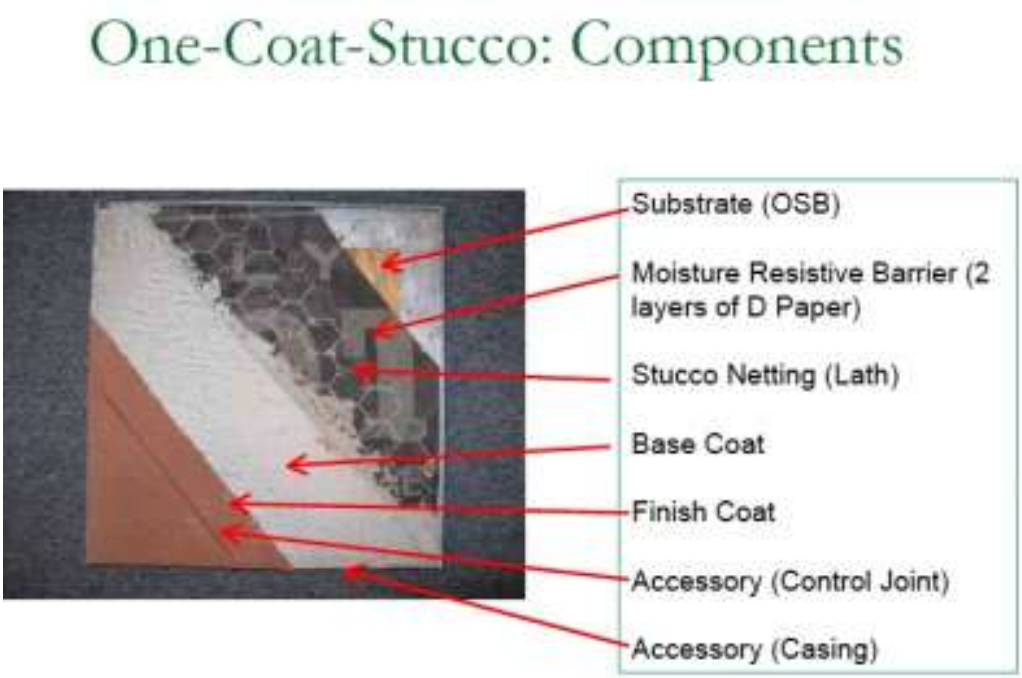
- Portland cement stucco;
- a moisture barrier, metal lath and accessories on moisture-sensitive substrates, but not on concrete or masonry substrates;
- it is hard and prone to cracking;
- it requires control or expansion joints every 144 square feet over lath, and 250 square feet without lath;
- it uses a metal or PVC casing bead, or J-bead or weep screed; and
- it has scratch, brown and finish coats.

One-Coat Stucco System

Basic components and characteristics include:

- many are proprietary, requiring ICC Evaluation Reports;
- it is composed of Portland cement stucco with polymers and fiberglass reinforcement;
- it requires a moisture barrier on moisture-sensitive substrates;
- it has a hard surface, which helps resist impact damage;
- control joints are required, but spacing should be specified by the design professional (typically, to limit panels to 144 square feet);
- it has a metal lath (stucco netting or diamond lath);
- it uses a metal casing bead, or J-bead or weep screed; and
- it has a minimum 3/8-inch base coat, plus a finish coat.

The incidence of cracking depends on the materials used and the installation techniques. There may or may not be foam insulation behind stucco; it can have EPS or XPS insulation behind the system. This does not make it an EIFS system as defined by the stucco or insurance industries. One-coat stucco systems are very popular since problems with EIFS have surfaced.



Quiz 7

T/F: Modern stucco is made of Portland cement, sand and water.

- True
- False

The most common type of EIFS is _____.

- barrier or face-seal PB-EIFS
- MD-EIFS
- PM-EIFS
- PI-EIFS
- DEFS

T/F: An MD-EIFS system employs a moisture barrier over its substrate.

- True
- False

T/F: Traditional or 3-coat stucco systems require a moisture barrier, metal lath and accessories on moisture-sensitive substrates.

- True
- False

Traditional or 3-coat stucco systems have _____ coats.

- scratch, brown and finish
- scratch, white and finish
- scratch, gray and finish

T/F: One-coat stucco systems are made with Portland cement with polymers and fiberglass reinforcing.

- True
- False

Control joints are required, but their spacing should limit panels to ____ square feet.

- 144
- 100
- 400
- 10

Section 13: Asbestos Cement-Based Siding

Asbestos Cement-Based Siding

This section deals with the common details of asbestos cement-based siding that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe what asbestos cement-based siding is; and
- list the common concerns related to the siding.

Asbestos and cement were first combined in the United States in the early 1900s to form an innovative, new building material. Asbestos cement is a composite material that consists of cement reinforced with asbestos fibers. Asbestos-cement siding shingles can be made to imitate the appearance of wood siding shingles in shape and appearance.

Asbestos fibers are a health hazard when inhaled. Asbestosis is a form of lung cancer that is caused by inhaling asbestos fibers. Because of the health risk, strict environmental regulations for working with asbestos were established in the U.S. Health risks were shown to be greatest during mining and production processes, but minimal during the installation and use of asbestos-cement products.

According to the U.S. EPA, a material containing asbestos is deemed potentially hazardous only in its friable state, which is when the material can be crumbled, pulverized, or reduced to a powder by hand pressure. Asbestos cement is not considered friable and, therefore, not hazardous because the cement binds the asbestos fibers and prevents their release into the air under normal-use conditions. However, asbestos-cement products are classified as friable when deterioration disturbs the asbestos. Asbestos-cement products are classified as friable when mechanical means are used for chipping, grinding, sawing or sanding, thereby allowing particles to become airborne.

If the asbestos-cement siding material is not disturbed, no hazard exists and no precautions are required. It is highly recommended that periodic inspections be conducted. Be sure to advise your clients about the need for this.

Maintain and Manage

Maintenance of asbestos-cement siding material includes performing visual inspections to evaluate its condition, keeping the siding clean, and making minor repairs, as necessary. It is important to maintain the environment around the house and to protect the asbestos-cement siding materials. Asbestos cement is brittle. It has little resistance to impact. The siding is susceptible to cracking and chipping. To protect the asbestos-cement siding material, one could plant small shrubs or flower beds between the bottom of the wall and the grass lawn. This landscaping feature will serve to protect the siding from lawnmower damage. A piece of trim detail could be added to the bottom of the asbestos-cement siding to reduce its vulnerability to cracking and chipping. Trimming the branches from nearby trees and bushes will protect the siding from damage.

Repair

When repair to asbestos-cement siding is needed, the least amount of siding should be discarded and the greatest possible amount of original material should be retained.

Cracking

If you see hairline cracks in the asbestos-cement siding, clear epoxy can be used in the cracks. Epoxy is susceptible to UV radiation from the sun and may need periodic maintenance. A grout of cement and water can be used to repair slightly larger cracks. To repair cracks greater than 1/8-inch, a thick grout with sand added to the mix can be used.

Fasteners

If the fasteners for the asbestos-cement product have become deteriorated or have broken due to corrosion, they should be replaced with a more durable metal. Stainless steel is generally recommended because of its superior corrosion resistance. Fasteners, such as nails, should be long enough to hold the materials securely.

Discoloration

Discoloration can be caused by surface contamination. Stains can result from a

leaching of other material, such as corrosion runoff. A change in color can be caused directly by the environment, such as UV radiation from the sun. Discoloration could be normal, but it may indicate a chemical reaction, decreasing the durability of the material.

Cleaning involves the use of solutions of varying strengths while using the gentlest physical means possible, without causing adverse conditions to the material. Mechanical methods for cleaning can promote asbestos fibers to become airborne and, therefore, should be used only by following strict asbestos regulations.

If discoloration or staining cannot be removed, the asbestos-cement siding could be painted, but this adds an additional maintenance factor.

Efflorescence

Efflorescence appears on many cement products that are exposed to weathering. This form of crystalline growth indicates that water is passing through the material, which can promote deterioration of the asbestos cement. Efflorescence is usually observed at the beginning of the material's life.

Biological Growth

Biological growth on the exterior of asbestos cement can be a problem in sheltered environments and on northern exposures. Shade trees located close to a building can shield sunlight and result in prolonged dampness of the asbestos-cement building product, promoting biological formations, such as moss and algae. These growths can stimulate surface deterioration and staining.

Replacement

Asbestos-cement siding material commonly deteriorates by cracking and chipping. Repairs are not usually performed on cracked or chipped pieces. Replacement is usually recommended. The replacement piece should be of a non-asbestos, fiber-cement type.

Replacing several pieces of asbestos-cement siding is easy to do because it has been manufactured in standard sizes, shapes, colors and textures. There are siding materials that have been manufactured to replicate asbestos-cement siding pieces. There are non-asbestos reinforced cement, fiberboard with asphalt, fiberglass, metal and vinyl available, too.

Inspection Tips for Asbestos-Cement Siding

Where siding is damaged, moisture can enter the building. Look for cracked or mechanically damaged pieces of siding. Mechanical damage can be caused by balls, stones, ladders or children. Be sure to check along the bottom edge and corners of the siding.

Quiz 8

According to the U.S. EPA, a material containing asbestos is deemed potentially hazardous only in its _____ state.

- friable
- frying
- freezing
- damaged
- dusty

T/F: If the asbestos-cement siding material is not disturbed, no hazard exists and no precautions are required.

- True
- False

Section 14: Clay and Slate Shingle Siding

Clay and Slate Shingle Siding

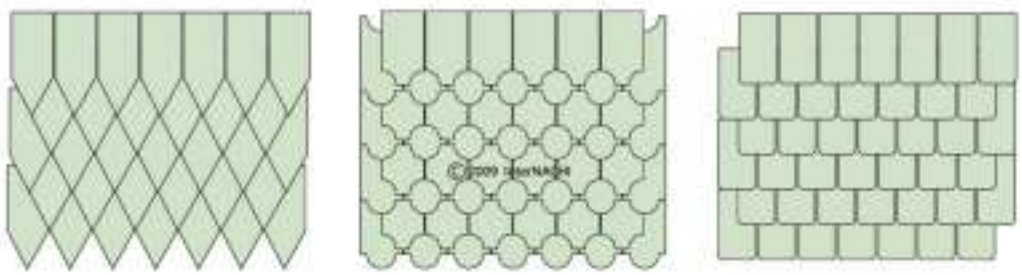
This section deals with the common details of clay and slate shingle siding that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how to identify clay and slate shingles; and
- list the common concerns related to the siding.

Clay and slate shingles are among the most historic building materials. Traditionally, clay tiles were formed by hand and, later, by machine-extrusion of natural clay, then textured or glazed with color, and fired in high-temperature kilns. The inherently fragile nature of clay shingles dictates that special care and precautions be taken to preserve and repair them. Clay roofing materials are commonly curved, whereas clay siding material is typically flat.

Clay and Slate Shingles



a few of the many different patterns used with clay and slate shingles

Clay and slate are resistant to water, sunlight and wind. They are not combustible. They are heavy and not prone to uplift by wind. Clay and slate shingles, when correctly installed, require little or no maintenance.

The fastening system used to secure the shingles to the wall often fails and needs to be replaced, as opposed to the shingles themselves. When the fastening system has deteriorated, or the wall support structure has failed, clay and slate shingles can be removed relatively easily, then necessary repairs can be made, and the shingles can be re-installed with new corrosion-resistant fasteners. Broken and damaged shingles should be replaced promptly to prevent further damage to adjacent shingles tiles and the supporting wall structure.

Clay and slate shingles have the longest life expectancies among siding materials – generally, 100 to 400 years. But regular maintenance is still recommended to prolong their life. A regular maintenance inspection of the clay or slate siding can help determine the condition, potential causes of failure, and the source of

any leaks, and will help in developing a program for the preservation and repair of the shingles.

Clay and slate shingles are most likely to deteriorate because of frost damage and deterioration or failure of the fasteners. The deterioration of the metal flashing around the shingles can also lead to the performance failure of the siding.

Clay and slate shingles are heavy, so it is important that the wall structure that supports the material be sound. If water damage has occurred behind the clay or slate siding materials, the evidence of damage may not be readily visible. Once the heavy siding materials start to lose their attachment to the substrate, they will then start to slide, slip, turn and fall. Their condition will then become apparent.

Efflorescence

Clay and slate shingles vary in quality from tile to tile. Efflorescence of soluble salts on the surface of a clay shingle may indicate that it has excessive porosity, which results from under-firing during its manufacture. Poor-quality, porous shingles are susceptible to breaking and exterior surface-spalling during freeze-thaw cycles. By letting in moisture, porous shingles can permit a wooden wall structure behind the siding to rot.

Damage

Clay and slate siding can be damaged by a variety of things, including tree branches, stones, balls, and heavy-impact hail.

Patching a clay or slate shingle with roofing tar, caulk, asphalt, pieces of metal, or non-matching clay tiles is inappropriate. Such treatments are visually incompatible. They also have the potential to cause physical damage. Water can collect behind these patches and accelerate the deterioration of the wooden structural components of the wall and the fastening system. During the expansion and contraction of a freeze-thaw cycle, ice buildup at patches can break surrounding tiles. Patching is not recommended; replacement of clay or slate siding pieces that are in poor condition is the best recommendation to make to homeowners.

Inspection Tips

Look for obvious damage, such as cracking and deterioration. Press on the clay and slate shingles with your hand. Check for movement of the pieces. Check for failure of the fasteners. Check for patching of the shingles. Observe and note any replacement shingles. If there has been any patching or repairs performed, ask the owner of the property for more information about the performance of the siding material in the past.

Quiz 9

T/F: The fastening system used to secure shingles to a wall often fails and needs to be replaced, as opposed to replacing the shingles.

- True
- False

T/F: Clay and slate shingles have the longest life expectancy among all siding materials, lasting between 100 to 400 years.

- True
- False

T/F: Clay and slate siding can easily withstand damage from a variety of things, including tree branches, stones, balls, and heavy-impact hail.

- False
- True

Section 15: Asphalt Shingle Siding

Asphalt Shingle Siding

This section deals with the common details of asphalt shingle siding that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

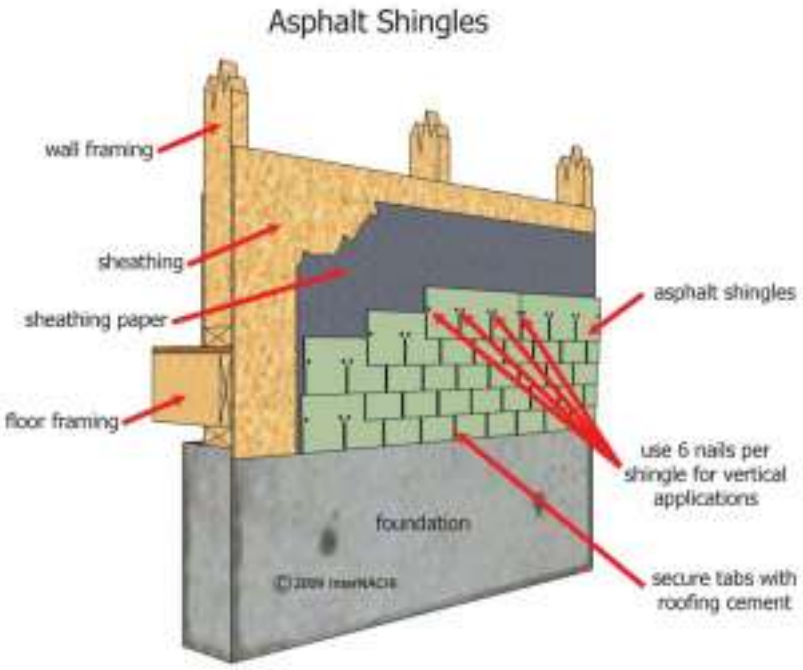
- describe how asphalt shingle siding functions; and
- list the common concerns related to the siding.

Asphalt shingles are sometimes used for siding material. The shingles used are the same used for a roof-covering system. When the roof-covering asphalt shingles are installed as siding, they need to be installed differently. The self-sealing tabs of asphalt shingles will not function because the shingles are installed vertically. The overlying shingle will not adhere to the shingle below. Roofing cement is commonly used to secure the layers of shingles to each other. Loose shingle tabs are susceptible to being blown or torn off by the wind.

Fastening

Asphalt shingles installed as siding need six nails or staples per shingle. This is

because gravity pulls more on shingles installed vertically, and more fasteners are needed when the shingles are installed on a wall, as opposed to when they're installed on a sloped roof.



Deterioration

Asphalt shingles deteriorate over time. As the asphalt shingle gets older, the granules are lost. The protective layering that wears away exposes the asphalt material. The volatiles in the asphalt evaporate away, and the shingle becomes brittle and shrinks, and quickly deteriorates.

Inspection Tips

Look for loose and missing shingles. Some shingles may tear, and one side of a shingle will fall and buckle outward. Touch the shingles slightly and check for movement. Tug slightly at the bottom edges of the shingles and check for poor adherence. Concentrate on the side of the house that is facing the prevailing

wind. Stand close to the wall and look up. Look for loose shingles that project outward.

Insulbrick®

Insulbrick® is a fiberboard sheathing coated with asphalt tar with embedded granules. It's a form of asphalt siding that attempts to mimic the look of brick. It was installed in the United States between the 1940s and 1960s to inexpensively insulate buildings and homes, and was usually nailed to the sheathing substrate. The material came in rolls and sheets, and was applied similarly to shingles to the sides of homes and commercial buildings.

Insulbrick® deteriorates fairly quickly. The material can break apart from the backing, leaving its brown-black covering behind. Insulbrick® has fallen out of favor with many insurance companies and lending institutions. It is rare to see it outside of established urban and historic areas, and is no longer manufactured.

Section 16: Masonry Exterior Wall Covering

16.0 Masonry Exterior Wall Coverings

This section deals with the common details of masonry exterior wall covering that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how a masonry exterior wall covering functions;
- describe the advantages and disadvantages of masonry exterior wall coverings;
- list the common concerns related to masonry exterior wall coverings;
- describe the differences between veneer and load-bearing;
- list the most common mortar joints;
- describe the function of weep holes; and
- describe how to control moisture at a masonry exterior wall.

Masonry is the building of structures from individual units laid in and bound together by mortar, and the term also refers to the units themselves. The common materials of masonry construction are brick, stone (such as marble, granite, travertine and limestone), concrete block, glass block, and tile. Masonry is generally a highly durable form of construction. However, the materials used, the quality of the mortar, the workmanship, and the pattern the units are assembled in can strongly affect the durability of the overall masonry construction.

Masonry is commonly used for the walls of houses, but its popularity depends sometimes on the geographical area. Brick and concrete block are common types of masonry. They may be either load-bearing (structural) or used as a veneer.

There is a variety of stone material that can be used for the masonry exterior siding. Stone may be hard, such as granite, or soft, such as limestone and sandstone.

Concrete bricks and blocks are created by the chemical reaction between Portland cement, sand, aggregate and water. Concrete may be plain or decorative, small or large, poured-in-place or pre-cast. Concrete may be shaped like bricks or made to look like stone.

Advantages of Masonry Siding

- Masonry provides good fire protection.
- Brick and stone can increase the thermal mass of a building, which can increase comfort in the heat of summer and the cold of winter. Masonry can be used effectively for passive solar applications.
- Masonry walls are more resistant to projectiles (such as debris from strong winds and impact from hailstones) than walls made of wood or other softer, less dense materials.

Disadvantages

- Frost damage can deteriorate masonry exterior walls. This type of damage is common with certain types of brick.
- Masonry is a heavy building material and requires support from a strong foundation (usually reinforced concrete) to avoid settling and cracking.

16.1 Concrete Blocks

Concrete blocks may be found on the exterior. Blocks of cinder concrete, called cinderblocks and breezeblocks, as well as traditional concrete or concrete blocks, are referred to as concrete masonry units, or CMUs. They differ from brick units in a few ways. They are usually much larger than bricks. Cinder and concrete blocks

typically have much lower rates of water absorption than brick. They are typically used as the structural core for veneered brick masonry. They are also used for the walls of detached garages and outbuildings.

A CMU wall can be reinforced by filling the open voids inside the block unit with concrete, with or without steel rebar. Steel reinforcement gives a CMU wall much greater lateral and tensile strength than unreinforced walls.

Some concrete blocks are colored. Some employ a split face, which is a technique that results in two blocks manufactured as one unit and then split in two. This gives the blocks a rough face that replicates the appearance of natural, quarried stone, such as brownstone. There have been many issues with split-face concrete blocks absorbing moisture and causing major water penetration and moisture intrusion problems.

16.2 Manufactured Stone

Manufactured stone, cultured stone, and man-made stone veneers are popular alternatives to natural stone. Natural stone has become very expensive in many areas. Manufactured stone veneers are typically made from concrete. Natural stones are re-created using molds, aggregate, and colorfast pigments. To the untrained inspector's eye, there may be no obvious, visual difference between veneers of natural stone and manufactured stone.

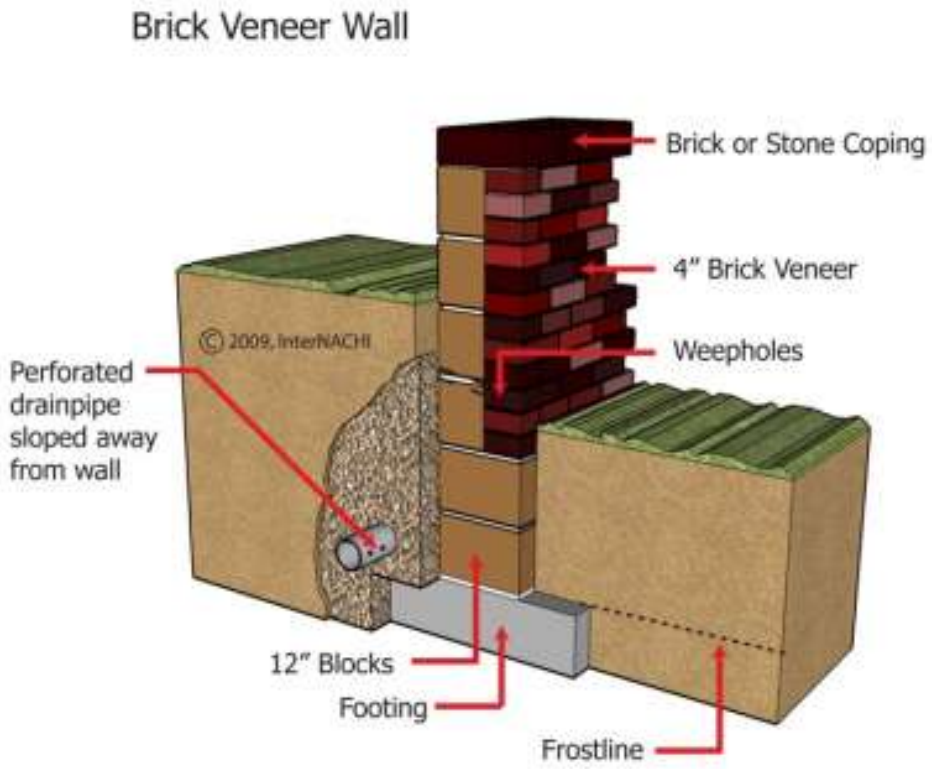
16.3 Load-Bearing or Veneer?

Masonry walls may be load-bearing, or they may be part of the structural support of the building, or they may be a veneer, acting as siding. To determine whether brick is load-bearing, you can look to see if there are header courses. Header courses of brick may indicate that the masonry wall is load-bearing. The absence of a header course or the presence of weep holes in the brick may suggest that the masonry is a veneer.

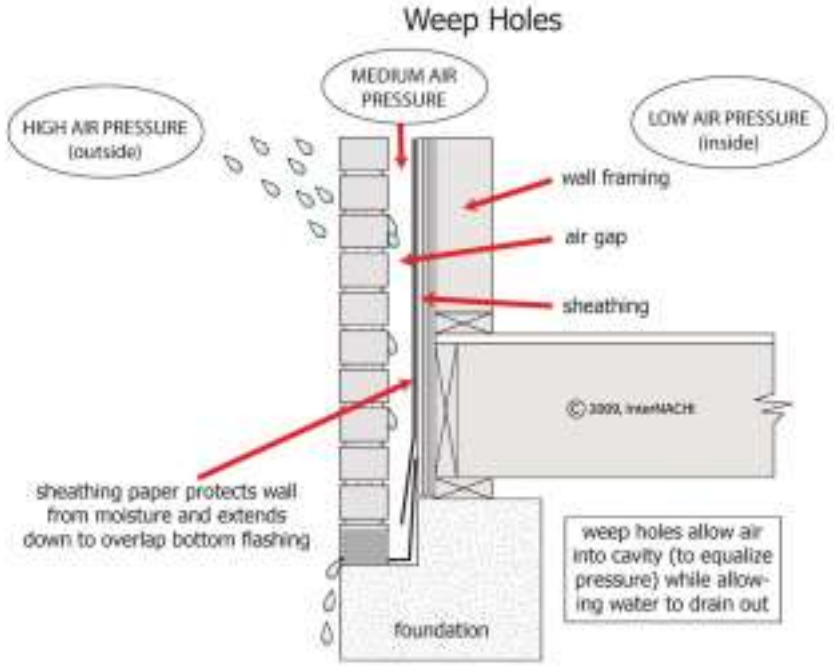
Veneer

A masonry veneer wall is installed on one or both sides of a structurally independent wall, usually constructed of wood or masonry. In this context, the brick masonry is primarily decorative and not structural.

The veneer can provide ornamentation, protection, insulation, or a combination of these features. It does not provide any structural strength to the wall, nor does it carry any load other than its own weight.

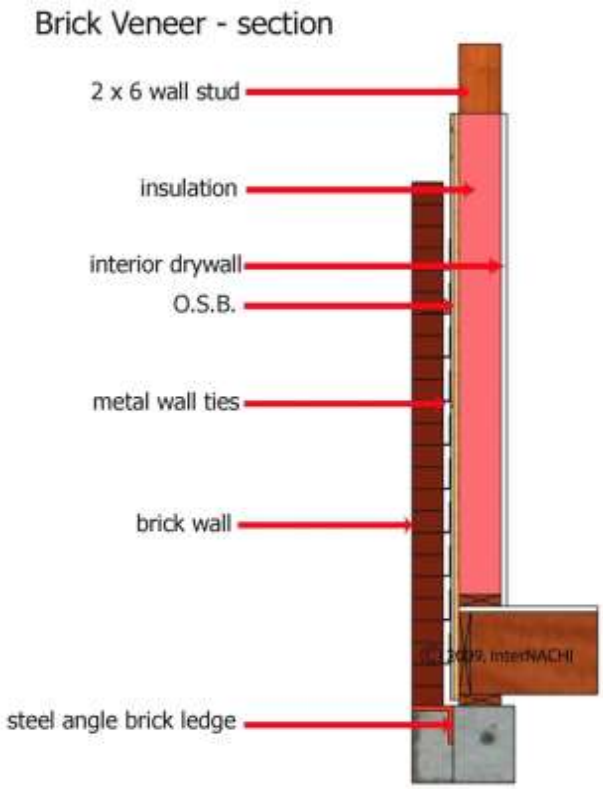


The brick veneer is generally connected to the structural wall by brick ties, which



are metal strips that are attached to the structural wall as well as to the mortar joints of the brick veneer.

Typically, there is an air gap between the brick veneer and the structural wall. Since masonry may not be considered completely waterproof, the structural wall behind the veneer usually has a water-resistant surface, such as tar paper or a housewrap material. Weep holes may be installed at the bottom of the brick veneer to drain moisture that accumulates inside the air gap.



Characteristics of a veneer wall:

- weep holes are installed;
- there are usually no arches;
- lintels are installed; and
- there are no header bricks.

Characteristics of a solid, load-bearing wall:

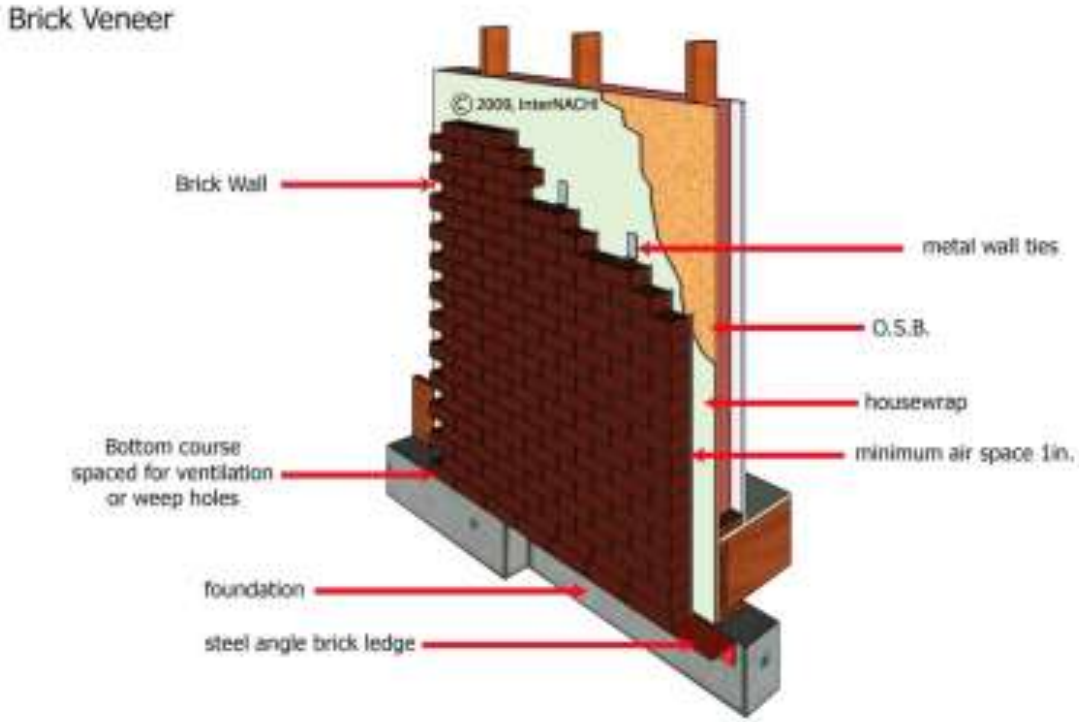
- there are no weep holes;
- it typically has arches;
- there are usually no lintels; and
- header bricks are installed.

Brick Ties

Two types of ties are approved for the attachment of masonry veneer to wood construction: corrugated sheet metal ties and metal strand wire ties. Both are corrosion-resistant.

The clearance between the veneer and the wood structural wall is limited and varies based on which type of tie is installed.

Where the veneer is attached to the wood wall by corrugated sheet metal ties, the air gap separating the veneer from the wall should not be less than 1 inch. Each tie should be spaced no more than 24 inches on-center horizontally and vertically. Each tie should support no more than about 3 square feet of wall area.



16.4 Common Problems with Masonry Exterior

Some common problems with masonry exteriors include:

- cracking;
- spalling;
- clearance;
- mortar deterioration;
- weep holes;
- moisture;
- efflorescence; and
- bowing.

Cracking

Part of the exterior inspection includes looking for cracks in the masonry exterior wall covering. Cracks in the individual masonry units are easier to see than cracks in the mortar joints. Cracks in the mortar joints are usually found where the mortar connects with the masonry unit, which is difficult to see.

Common causes of cracks in the exterior masonry wall include:

- settlement;
- premature form removal;
- low-quality concrete;
- poor backfill practices;
- thermal expansion and contraction;
- frost damage; and
- physical damage.

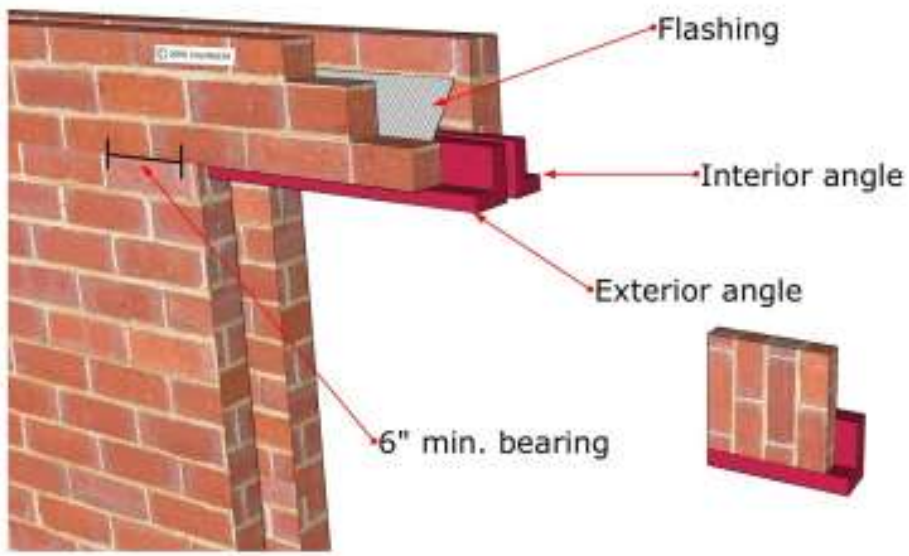
Types of Settlement

Cracks are commonly caused by the house settling. They can also be caused by the masonry units expanding and contracting because of the changes in temperature or by the absorption of moisture.

Cracks may allow water to penetrate the building. They may be cosmetic. And cracks may indicate major structural problems.

Cracks are commonly found at lintels. When a lintel develops rust, the steel expands

and pushes up on the masonry units of the wall. A rusting lintel can cause horizontal and step cracks in the masonry. The cracks then expand outward from the top corners of door and window openings.



Spalling

Masonry deterioration may happen by spalling, which is mechanical weathering that can be caused by freezing, thawing, thermal expansion and contraction, and salt deposition. Direct spraying of water onto masonry can cause mechanical damage and spalling. Spalling can be described as crumbling or flaking at the masonry's surface.

Freeze-thaw cycles can cause damage by moisture freezing inside cracks in the masonry. Upon freezing, its volume expands, causing large forces that crack and spall off the outer surface. As this cycle repeats, the outer surface undergoes spalling and can result in major damage. The severity of the damage is related to the amount of moisture absorbed, the porosity or permeability of the brick, and the number of freeze-thaw cycles.

Spalling can be caused by:

- moisture being wicked up from the ground;
- moisture entering the masonry wall as a vapor;
- exposure to direct rainfall;
- water spilling onto the surface from the gutter system or roof surface;
- sandblasting, pressure-washing, and chemical cleaning of the masonry wall surface; and

- the application of a non-breathable wall sealer.

Salt Spalling

Salt spalling is a specific type of weathering that can occur in brick, natural stone, tiles and concrete. Dissolved salt is carried through the material in water and then crystallizes inside the material near the surface as the water evaporates. As the salt crystals expand, this builds up shear stresses that break away and create spalling at the surface.

Some homeowners believe that porous building materials can be protected against salt spalling by treatment with water-repellent sealants that penetrate deeply enough to keep water with dissolved salts well away from the surface. Expert advice should be sought to ensure that any coating applied is compatible with the substrate in terms of its breathability, which is the ability to allow the release of vapors from inside while preventing water intrusion, or other serious problems can be created.

During your inspection, you may be told that the masonry has been recently cleaned and then sealed. Some sealants are silicone-based and are not permeable. Such a sealant will act like a plastic skin and will trap moisture.

It must always be assumed that water — possibly arriving in the form of vapor from the interior — will collect behind the wall surface, and it must be allowed to both drain and evaporate. Many bricks and stones have been damaged beyond repair by the well-intentioned application of the wrong coating, once the coated masonry has gone through a few freeze-thaw cycles.

You usually will not be able to confirm if a masonry wall has been sealed, but you will be able to inspect and report the condition of the masonry.

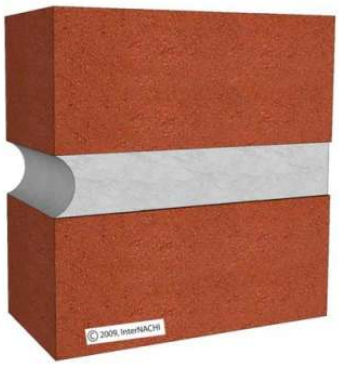
Clearance

Most types of bricks should be kept above the ground's surface with adequate clearance. Some bricks are designed for use underground. If you see spalling at the bricks near grade level, and the bricks above appear to be in good condition, then these bricks may not have been intended for use underground.

Mortar Deterioration

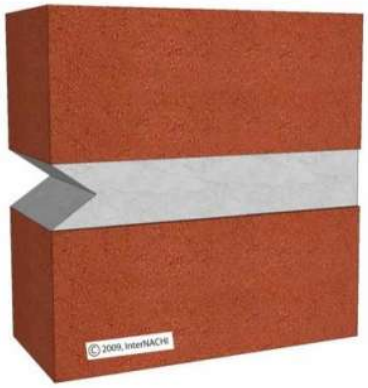
Although good-quality bricks may outlast civilizations, the mortar that bonds them can crack and crumble after a number of years. Water penetration is the greatest degrader of mortar, and different mortar joints allow for varying degrees of water resistance. Mortar joints in brickwork also take up a large amount of a wall's surface area and have a significant influence on the wall's overall appearance. Some joint profiles accentuate their individual designs, while others merge the bricks and mortar to form a flush, homogeneous surface.

Concave



The following are the most common types of mortar joints.

"V"



Concave Joint

This popular type of joint is formed in mortar through the use of a curved, steel-jointing tool. It is very effective at resisting rain penetration due to its recessed profile and the tight seal formed by compacted mortar. Patterns are emphasized on a dense, smooth surface, and small irregularities are hidden.

V-Joint

This type of joint can be made with a V-shaped jointer or a trowel soon after the bricks are laid. Ornamental and highly visible, the joint conceals small irregularities and is highly attractive. Like the concave joint, the V-joint is water-resistant because its formation compacts the mortar and its shape directs water away from the seal.

Weathered

Weathered Joint

Mortar is recessed increasingly from the bottom to the top of the joint, with the top end not receding more than 3/8-inch into the wall. The straight, inclined surfaces of the bed (horizontal) joints tend to catch the light and give the brickwork a neat, ordered appearance. This joint is less compacted than the concave and V-joints, although it is still suitable for exterior building walls.

Grapevine Joint

While most popular during America's Colonial period, this design is often replicated in newer brickwork. It is created with a grapevine jointer, which is a metal blade with a raised bead that creates an indented line in the center of the mortar joint. These lines are often rough and wavy, simulating the generally straight yet slightly irregular appearance of a grapevine. It is commonly used on matte-finish and antique-finish brickwork.

Grapevine

Extruded

Extruded (Squeezed) Joint

This joint design requires no tooling and is formed naturally as excess mortar is squeezed out from between the bricks. The result is a rustic, textured appearance that is especially attractive in garden settings. This design is not recommended for exterior building walls due to the tendency for exposed mortar to break away, degrading the wall's appearance.

Beaded Joint

Raising a rounded, bead-shaped segment of the mortar away from the mortar surface produces this old-fashioned, formal design. Although beaded joints can create interesting shadows, they are not recommended for exterior use due to their exposed ledges.

Beaded

Struck Joint

Struck

This joint is formed in a fashion similar to the weathered joint, except that the bottom edge, instead of the top edge, is recessed. It is a very poor insulator against water, as it will allow water to collect on its bottom ledge.

Raked Joint

For this design, mortar is raked out to a consistent depth. Although often left roughened, it can be compacted for better water resistance. This design highly emphasizes the joint and is sometimes used in modern buildings in order to match the historic appearance of their locales. Unless it is compressed, it is not as water-resistant as other mortar joints because the design incorporates ledges, which will collect water as it runs down the wall. Also, when mortar is removed from the joints, it becomes smeared on the surfaces of the brick at the recesses. To remove the mortar, contractors often aggressively clean the walls with pressurized water or acid solutions, which can open up additional voids and increase the possibility of water penetration.

Raked

Flush Joint

This joint is best used when the wall is intended to be plastered or joints are to be hidden under paint. Because the mortar is not compressed, it is less water-resistant than some of the other designs.

Flush

Inspection Tip for Mortar Joints

While inspecting the exterior, pay attention to the condition of the mortar joints. Deteriorated mortar may allow water to penetrate the wall. Check mortar joints with a screwdriver by scraping it along the mortar joints. Dragging the screwdriver along the mortar joint may provide a good indication of the mortar's condition.

Weep Holes

Modern masonry veneer walls should have drainage provisions installed. Weep holes allow water that has reached the space behind the veneer to drain out of the wall system. Weep holes can be created by simply leaving out the mortar from every fourth or fifth vertical joint in the bottom course of the wall. Flashing installed at the bottom of the wall will direct the water out of the weep holes.

Weep holes can be an integral part of a vented rainscreen. This screen reduces the amount of water that can be forced through a masonry veneer wall during wind-driven rains. During a wind-driven rainstorm, there is a positive, high pressure on the outside of the masonry wall, and a low or atmospheric pressure at the interior. This pressure difference can drive moisture into the masonry material and through the wall.

Modern masonry veneer walls have a cavity or air space behind them. This air space is typically 1 inch wide and located between the masonry and the interior wall. This space is vented to the outside with the use of weep holes located at the bottom of the wall. During heavy windstorms, air enters the weep holes and pressurizes the space behind the masonry veneer. As a result of this pressurized air space, there is a smaller pressure difference across the masonry units. Less water will move into and through the masonry.

If water goes through the masonry, it will drain down the air space or rainscreen. The water will reach the weep holes at the bottom of the wall and will be directed outside by the flashing. Weep holes let air and water pass through them.

Inspection Tip for Weep Holes

Inspectors should check for weep holes at veneer walls. You should check for damage that may be caused by the lack of weep holes. Look at the top of the foundation wall on the inside of the house where the house structure meets the top of the foundation. An absence of weep holes may be indicated by water marks or moisture found in this area. Watermarks in this location may also indicate a problem with the flashing at the weep hole area. But flashing at weep holes will

likely not be readily visible to an inspector. Remember to pay attention to the wall or walls that face wind-driven rains.

Inspection Tips for Moisture

Remember that water is the enemy of masonry. Closely inspect:

- areas near the bottom of walls;
- at wall penetrations;
- behind downspout pipes;
- below gutters;
- at attached handrails;
- below windows;
- behind dense vegetation where water may be held up against the masonry exterior wall covering; and
- any areas that might accumulate water.

Best Practices for Controlling Moisture at Brick Veneers

The main function of the building envelope is to keep out moisture. When it comes to brick veneer walls, you should understand some of the best practices that may be applied to prevent moisture problems. The following are some of the best practices that you may see at a brick veneer:

- The appropriate brick type and mortar for the weather conditions should be present. This is not readily ascertainable during a typical home inspection.
- If there is a way to check behind the veneer during an inspection, look for an air space, which should be at least 1 inch. Some installers create an air space of 2 inches wide. It should be wide enough to accommodate rigid insulation board.
- A flexible and strong through-wall flashing membrane could be installed. The membrane should be one that will not disintegrate over time (5 ounces per square foot of copper is time-proven). It should run to the exterior face of the mortar joint. All that you will usually see is the outer edge of the flashing popping through the mortar joint surface.
- The through-wall flashing should be lapped. The overlaps may be a minimum of 6 inches, and fully sealed.
- Upright legs 12 inches high may be installed on the supporting wall. End dams should be provided at all corners and discontinuities. The end dams should be sealed.
- The through-wall flashing should be step-flashed and overlapped by 8 to 16 inches along the slopes.
- The brick ties, reinforcing termination bars, and fasteners should be stainless steel.

- Where rigid insulation is installed, the joints of the boards should be spray-foamed.
- A flexible, impermeable membrane could be applied on the supporting wall surface.
- 100% cotton rope wick weeps -- not polyester strands -- should be used at the weep holes. The weep holes could be installed to weep the through-wall flashing at 16 inches on center. The weep holes are essentially connected to each other by linking each wick. Each rope wick is run horizontally in the wall cavity 16 inches to the next wick, and then the rope turns vertically for 8 inches. The wick should extend out from the face of the wall by ½-inch to catch air and evaporate and wick the moisture out.
- Expansion joints may be installed in the veneer.
- Mortar net mesh could be installed above each level of through-wall flashing to prevent mortar droppings from clogging the cavity.

Efflorescence

Efflorescence often occurs on masonry, particularly brick, when water moves through a wall and brings out salts to the surface that are not commonly bound as part of the concrete. As the water evaporates, the salts are left behind. The salts appear as white, fluffy deposits that can usually be simply brushed off by hand. The resulting white deposits are referred to as efflorescence. Efflorescence is sometimes referred to as salt-petering. Since primary efflorescence brings out salts that are not ordinarily part of the cement stone, it is not a structural concern but, rather, an aesthetic one.

Bowing

Inspectors sometimes find masonry veneer walls that show signs of bowing. Bowing occurs when a masonry veneer wall projects outward, away from the wood framing or masonry structure behind the veneer. Bowing is typically found on old buildings. Masonry veneer walls have metal tie attachments. The ties are intended to connect and securely attach the veneer wall to the structural wall behind the veneer. In older homes, the ties may be simple nails. In newer homes, the current building practice is to use corrugated, galvanized steel strips. They are shaped like an L-bracket and are about 1 inch wide. The vertical part of the L-

shaped tie is nailed to the building, and the horizontal part sticks outward and is embedded into the mortar joint. Metal ties are not readily visible during an inspection.

A bowing wall may indicate a problem with the attachment to the structure. The ties may have pulled out of the structural frame of the building. They may have pulled out of the mortar joint, or rusted or deteriorated, or there may be inadequate lateral support. Ultimately, a bowing wall may result in a catastrophic failure.

A bowing wall is usually bulging outward from its middle. The top of the wall is held in place by the roof structure, and the bottom of the wall is held in place by the load of the wall placed on the foundation.

Sometimes, a new wood frame structure built with green wood may shrink. However, the masonry will not shrink, and the shortening of the wood frame structure may result in the failure of ties and the bowing out of the masonry veneer at the midpoint of the wall.

Bowing sometimes occurs around the window and door openings, or near the top of the wall.

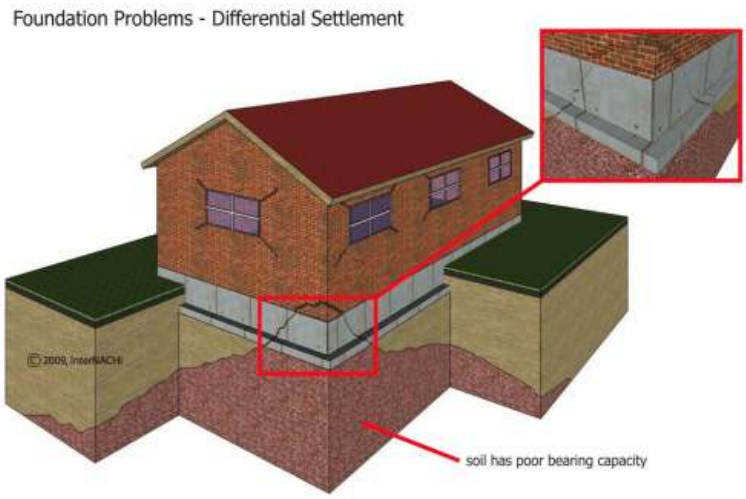
Metal plates or stars installed on the wall surface may indicate that a structural attempt has been made to secure the wall in place. These attachments may have been installed during original construction or sometime afterward. The plates or stars may be on opposite sides of a masonry building and tied together with steel rods or cable connections.

Inspection Tips for Bowing Walls

Look for water penetration caused by the bowing. When a wall bows out, gaps and openings around windows and doors may be created. Weathertightness may be lost. When looking for bowing walls, look up and down the walls by placing your line-of-sight tightly along the wall surface. A long level or plumb bob may be used to confirm your observations.

16.5 Foundation Cracks and Water

It is important to understand that all concrete and masonry construction will develop cracks due to shrinkage effects. As these cracks widen over time (usually due to small amounts of differential settlement in the soil supporting the foundation), the pathways for water intrusion through the foundation increase.



Visible cracks are usually a concern to homeowners even though they often have little effect on the structural integrity of the foundation. The question becomes how to best control these cracks.

The optimum location for reinforcement to control cracking and prevent differential settlement is at the top and bottom of the foundation wall in a horizontal direction. Horizontal reinforcing of this type should be considered in addition to adhering to code-required vertical reinforcement. By placing horizontal reinforcement, the wall acts as a deep beam, even after cracks initially form due to the effects of shrinkage during the concrete's curing process. If the wall is adequately tied or doweled to the footing, then the reinforcement in the bottom of the wall may be placed horizontally along the length of the footing. The reinforcement at the top of the wall is known in masonry construction as the bond beam. Alternatively, truss-type reinforcing wire may also be used between horizontal courses of masonry block.

Epoxy Sealant for Masonry Cracks

An epoxy sealant can be injected into cracks of masonry foundation walls. Poured concrete foundation walls are often found to have cracks. Typically, these cracks are shrinkage cracks, and not an indication of major structural problems. The only problem with a shrinkage crack in a poured concrete foundation wall, other than cosmetic appearance, is water penetration through the crack. Epoxy sealant is an easy and relatively inexpensive solution to the water problem.

To seal the cracks this way, they must first be cleaned and exposed, and maybe even

enlarged in some areas. A sealant is then applied over and along the crack. It serves as a barrier for the injection material, and also holds the injection nozzle in place so that no drilling of the foundation is necessary. The resin compound is a moisture-activated, flexible material that provides a permanent seal, even if there is future movement in the foundation. Next, the epoxy is injected. The epoxy is a two-part material consisting of resin and a hardener. When mixed, these liquids create a SuperGlue®-like bond. Injecting a crack with epoxy resin is ideal for cracks where there will be little or no movement in the foundation.

Epoxy sealant can be applied at block foundation walls and at concrete floors of basements and garages.

Quiz 10

Asphalt shingles installed as siding need _____ nails or staples per shingle.

- six
- eight
- four
- 12

T/F: Roofing cement is commonly used to secure the layers of shingles to each other.

- True
- False

T/F: Siding material is considered insulation.

- False
- True

T/F: Properly prepared concrete block accepts paint well.

- True
- False

T/F: Masonry provides good fire protection.

- True
- False

Brick and stone can increase the _____ of a building, which improves comfort in the heat of summer and the cold of winter.

- thermal mass
- weight
- structural integrity
- appearance

Masonry is a heavy building material and requires support by a strong _____ to avoid settling and cracking.

- foundation
- mortar reinforcement
- attachment
- capping

T/F: Header courses of brick may indicate that the masonry wall is load-bearing.

- True
- False

The absence of a header course or the presence of weep holes in the brick may suggest that the masonry is a _____.

- veneer
- solid block
- solid masonry

There is typically _____ between the brick veneer and the structural wall.

- an air gap
- a structural I-beam
- cellulose insulation
- water-resistant drywall

_____ may allow water to penetrate the building, and may be merely cosmetic, or they may indicate major structural problems.

- Cracks
- Mechanically damaged areas
- Penetration holes
- Weep holes

T/F: Most types of bricks should be kept above the ground surface with adequate clearance.

- True
- False

Masonry veneer walls should provide a drainage capability in the form of _____.

- weep holes
- moisture ties
- water pipes
- drain plugs

_____ often occurs on brick masonry when water moves through a wall and brings out salts to the surface that are not commonly bound as part of the concrete.

- Efflorescence
- Fluorescence
- Blackening
- Staining

T/F: A bowing veneer wall may indicate a problem with its attachment to the structure.

- True
- False

Section 17: Inspecting the Visible Masonry and Foundation

17.0 Inspecting the Masonry and Foundation

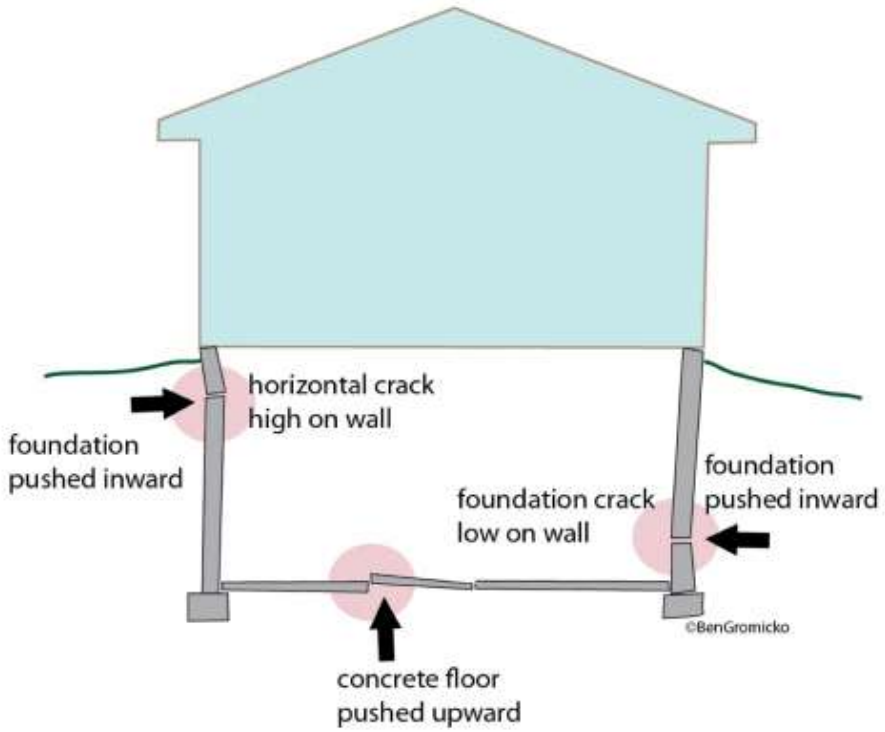
This section deals with the inspection of the visible masonry and foundation of the house exterior that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- list common concerns related to masonry;
- describe the different types of cracking that may be observed;
- list the common causes of cracking and settlement; and
- describe common moisture and thermal movement cracking.

17.1 Checking the Masonry

Check the masonry walls of the house. All exposed masonry should be inspected for cracking, spalling, bowing (bulging vertically), sweeping (bulging horizontally), leaning, and mortar deterioration.



Although masonry can deform elastically over long periods of time to accommodate small amounts of movement, large movements normally cause cracking. Cracks may appear along the mortar joints or through the masonry units.

Cracking can result from a variety of problems, including:

- differential settlement of the foundation;
- drying shrinkage, particularly in concrete block;
- expansion and contraction due to ambient thermal and moisture variations;
- improper support over openings;
- the effects of freeze-thaw cycles;
- the corrosion of iron and steel wall reinforcement;
- differential movement between building materials;
- expansion of salts; and
- the bulging or leaning of walls.

Cracks should always be further evaluated to determine their cause and whether corrective action is required.

Cracking May Be the Result of Bad Practice

Good concrete construction practices are also important to minimize foundation cracking and porous concrete (voids) that can create a greater potential for water intrusion at the foundation. Good concreting practices include: the use of an appropriate mix design, such as minimum 3,000 psi concrete; maintaining a low water-to-cement ratio by minimizing the use of water to decrease concrete porosity; and vibrating the concrete for good consolidation in forms.

Look for Signs of Movement

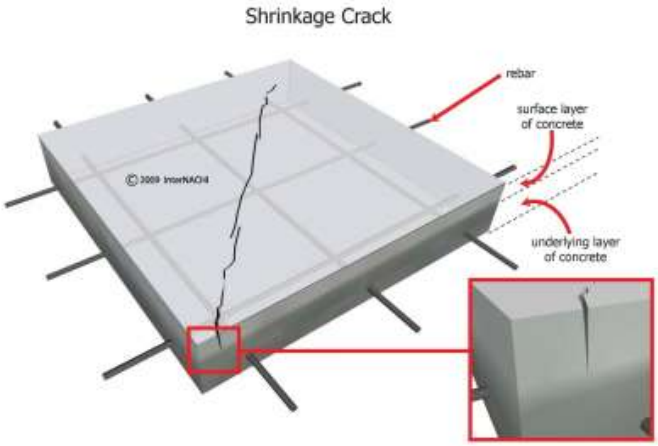
A clean crack indicates recent movement. A dirty or previously filled crack may be inactive. Correlate the width of larger cracks to the age of the building. A ½-inch crack in a new building may be a sign of rapid settlement, but in a building 50 years old, it may indicate a very slow movement of only 1/100 of an inch (0.25 mm) per year.

Crack movement can be measured with a commercially available joint-movement indicator. This device is temporarily fastened over the crack and a scribe records movement over a period of time.

Cyclical

Cyclical movements may take six months or more to measure, but diurnal movements can be recorded over a few days. Cracks associated with thermal expansion and contraction may open and close with the season. These are cyclical cracks, which may gradually expand as accumulating mortar debris jams them farther apart after each cycle. Such cracks should be cleaned and protected with flexible sealants. Re-mortaring cyclical cracks will hold them open and cause more cracking.

When there are major masonry problems, an inspector should recommend further evaluation by an expert, such as a structural engineer. If problems appear to be due to differential settlement, evaluation by a soil engineer may also be required.



Mortar Deterioration

The age of the building may be a good clue in evaluating its mortar problems. The two important qualities of mortar are its ability to bond to masonry and its internal strength. Older mortar (or mortar of any age that uses hydrated lime) will be softer and may require re-pointing, but otherwise will make a sound wall.

Moisture

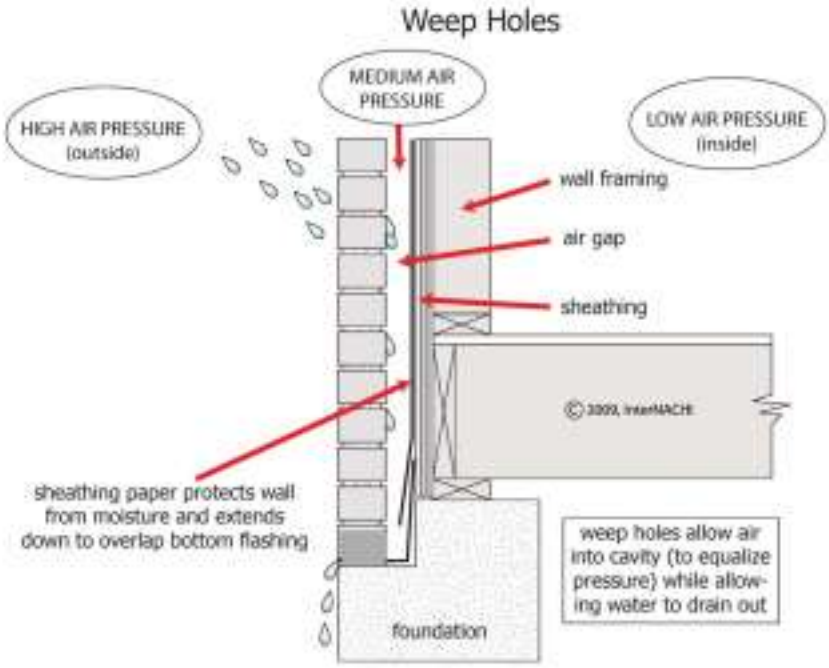
Most often, mortar deterioration is found in areas of excessive moisture, such as near leaking downspouts, below windows, and at the tops of walls. In such cases, the remedy is to redirect the water flow and re-point the mortar joints. Re-pointing should be performed with mortar of a composition similar to or compatible with the original mortar. The use of high-strength mortar to re-point mortar of a lower strength can do serious damage to the masonry because the pointing can't flex with or act in a way similar to the rest of the joint.

It is useful to remember that mortar acts as a drainage system to equalize hydrostatic pressure within the masonry. Nothing should be done to reduce its porosity and thereby block water flow to the exterior surface.

Deterioration of Brick

The spalling, dusting or flaking of brick masonry units may be due to either mechanical or chemical damage. Mechanical damage is caused by moisture entering

the brick and freezing, resulting in spalling of the brick's outer layers. Spalling may continue, or it may stop on its own after the outer layers that trapped the interior moisture have broken off. Chemical damage is due to the leaching of chemicals from the ground into the brick, resulting in internal deterioration. External signs of such deterioration are a dusting or flaking of the brick. Very little can be done to correct existing mechanical and chemical damage except for actually replacing the brick. Mechanical deterioration can be slowed or stopped by directing water away from the masonry surface and by pointing mortar joints to slow water entry into the wall.



17.2 Masonry Foundations and Piers

At the foundation walls (stone, brick, concrete or concrete block foundations), look for the following problems.

Uneven Settlement

Uneven or differential settlement can be a major structural problem in small residential buildings. Serious settlement problems are relatively uncommon. Many signs of masonry distress are incorrectly diagnosed as settlement-related when, in fact, they are due to moisture and thermal movements.

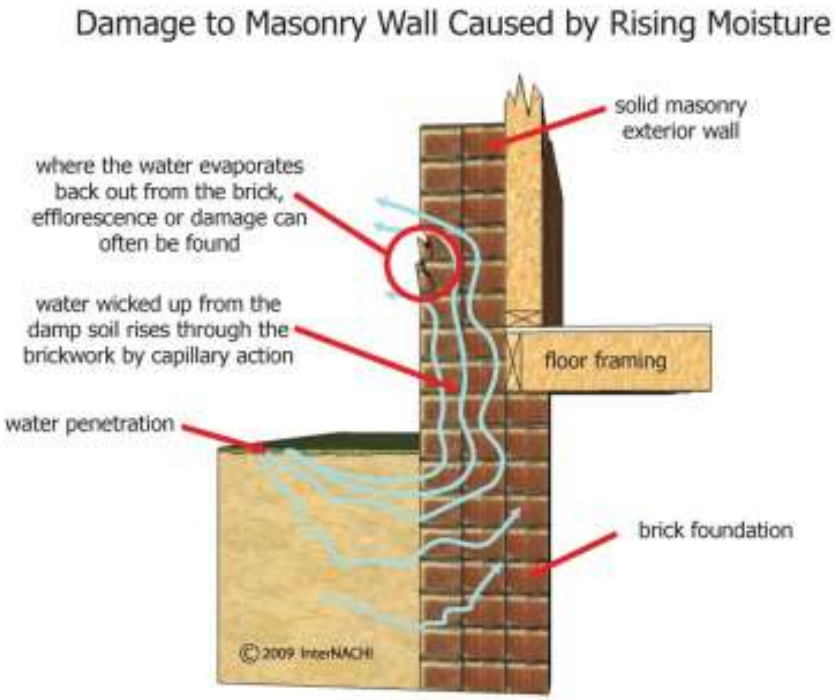
Indications of Settlement

Indications of differential settlement include:

- vertical distortion or cracking of masonry walls;

- warped interior and exterior openings;
- sloped floors; and
- sticking doors and windows.

Settlement most often occurs early in the life of a building, or when there is a dramatic change in underground conditions. Often, such settlement is associated with improper foundation design, particularly inadequate footers and foundation walls.

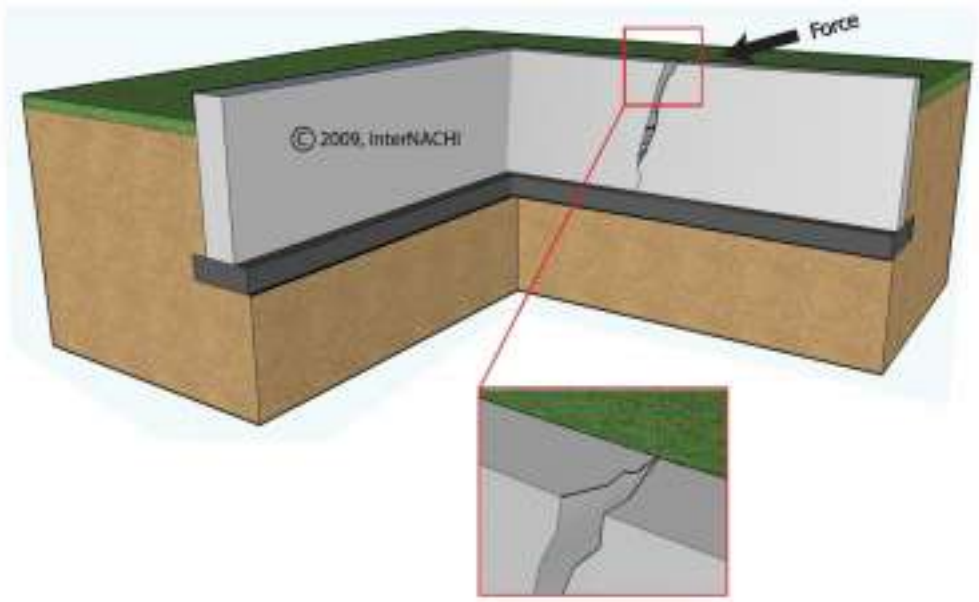


Other causes of settlement are:

- soil consolidation under the footings;
- soil shrinkage due to the loss of moisture to nearby trees or large plants;
- soil swelling due to inadequate or blocked surface of the house's drainage;
- soil heaving due to frost;
- soil heaving due to excessive root growth of nearby trees;

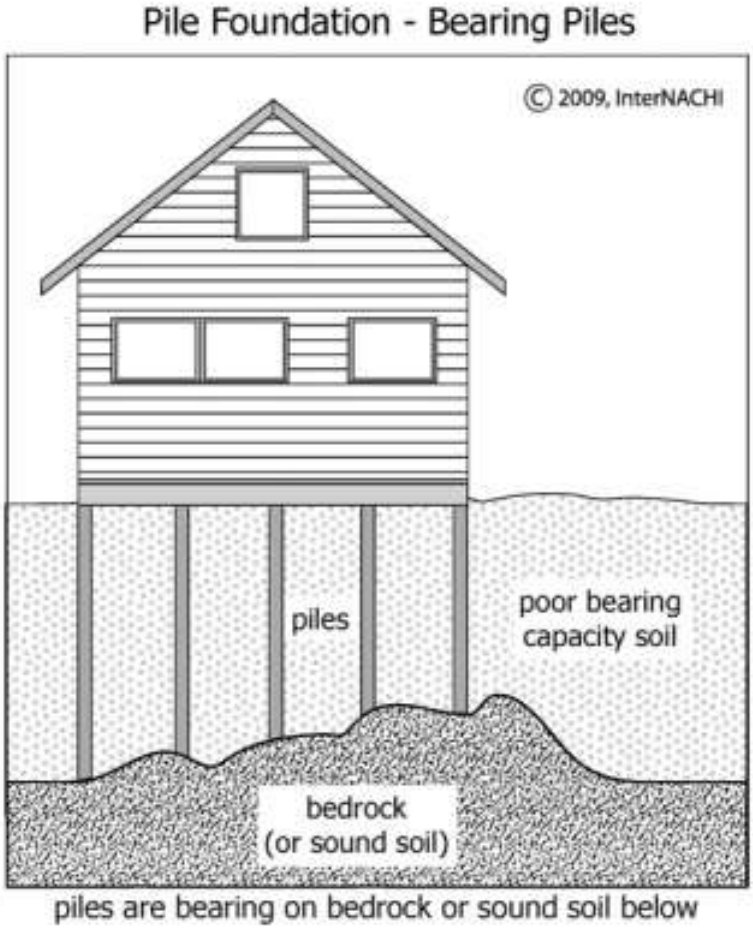
- the gradual downward drift of clay soil on slopes;
- changes in water table level;
- soil erosion around footers from poor surface drainage, faulty drains, leaking water mains, or other underground water movements. Occasionally, underground water may scour away earth along only one side of a footer, causing its rotation and the subsequent buckling or displacement of the foundation wall above; and
- soil compaction or movement due to vibration from heavy equipment, vehicular traffic, construction blasting, or from ground tremors (earthquakes).

Foundation Cracks:
Vertical Crack from Hydrostatic Pressure



Gradual differential settlement over a long period of time may produce no masonry cracking at all, particularly in walls with older and softer bricks and high-lime mortars. The wall will elastically deform instead. More rapid settlement, however, produces cracks that taper, being largest at one end and diminishing to a hairline at the other, depending on the direction and location of settlement below the wall.

Cracking is most likely to occur at corners and adjacent to openings, and usually follows a rough diagonal along mortar joints (although individual masonry units may be split). Settlement cracks -- as opposed to the similar-appearing shrinkage cracks that are especially prevalent in concrete block -- may extend through contiguous building elements, such as floor slabs, masonry walls above the foundation, and interior plaster work.



Tapering cracks, or cracks that are nearly vertical and whose edges do not line up, may occur at the joints of projecting bay windows, porches and additions. These cracks indicate differential settlement due to inadequate foundations or piers under the projecting element. Often, settlement slows a short time after construction, and a point of equilibrium is reached when movement no longer occurs.

Minor settlement cracking is structurally harmful only if long-term moisture leakage through the cracks adversely affects building elements. Large differential settlements, particularly between foundation walls and interior columns or piers,

are more serious because they will cause movements in contiguous structural elements, such as beams, joists, floors and roofs, that must be evaluated for loss of bearing and, occasionally, fracture.

Repair

If the foundation needs repair, it can be accomplished by the addition of new structural elements, such as pilasters, or by pressure-injecting concrete epoxy grout into the foundation wall. Pilasters can be either structural or ornamental. Incorporating masonry structural pilasters, thicker and stronger wall sections, to a masonry foundation wall can be an alternative way to provide lateral support. If movement continues and cracking is extensive, it is possible that the problem can be rectified only by underpinning. Older buildings with severe settlement problems may be very costly to repair.

Masonry Piers

Masonry piers are often used to support internal loads on small residential buildings, or to support projecting building elements, such as bay windows, porches and additions. In some cases, they support the entire structure. Piers often settle differentially and, over a long period of time, particularly when they are exposed to the weather, they tend to deteriorate.

Pier Problems

Piers should be plumb, without major settlement, in good condition, and adequate in accepting bearing loads. Their width-to-height ratio should not exceed 1:10. Those that are deficient should be repaired or replaced. When appearance is not a factor (as is often the case), piers can be supplemented by the addition of adjacent supports.

Settlement or rotation of the pier footing can cause a lowering or tilting of the pier and subsequent loss of bearing capacity. Wood-frame structures adjust to this condition by flexing and redistributing their loads, or by sagging. Masonry walls located over settled piers will crack.

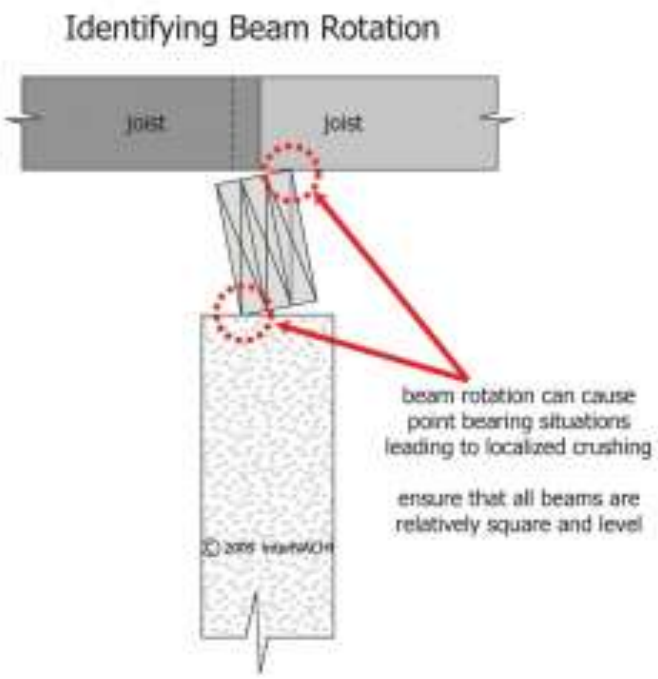
Frost-heaving of the footing or pier, a condition caused by the lack of an adequate footing, or one of insufficient depth, can raise or tilt a pier. This could show up as movement similar to that caused by settlement or rotation of the footing. Such a condition is most common under porches and decks.

Above-ground piers exposed to the weather are subject to freeze-thaw cycles and subsequent physical damage. Deterioration of the pier could be caused by exposure, poor construction, or over-stressing. Piers for many older residential structures are often of poorly constructed masonry that deteriorates over the years. A sign of over-

stressing of piers is vertical cracking or bulging.

Problems with piers can result in problems with bearing of wooden components. Structural wooden components can lose bearing when piers move or deteriorate.

Check for beam rotation. Beam rotation can cause point-bearing situations leading to localized crushing. Ensure that all beams are relatively square and level.



17.3 Shrinkage Cracking

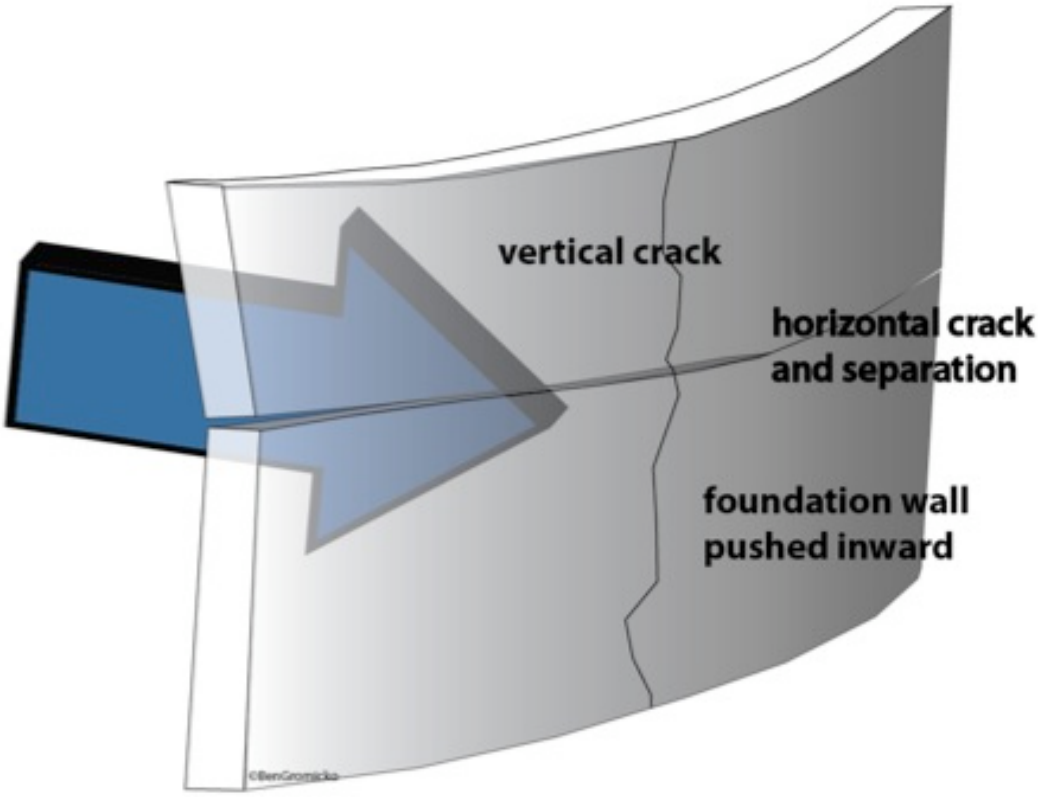
Cracking can form from the drying shrinkage in concrete-block foundation walls. As they dry in place, the shrinkage of concrete block walls often results in patterns of cracking similar to that caused by differential settlement, resulting in tapering cracks that widen as they move upward diagonally. These cracks usually form during the building's first year. In existing buildings, they will appear as old cracks and exhibit no further movement.

Although such cracks are often mistaken for settlement cracks, shrinkage cracks usually occur in the middle third of the wall, and the footer beneath them remains intact. Shrinkage cracking is rarely serious, and in an older building may have been repaired previously. If the wall is unsound, its structural integrity sometimes can be restored by pressure-injecting concrete epoxy grout into the cracks, or by adding structural pilasters.

17.4 Sweeping or Horizontal Cracking

The sweeping or horizontal cracking of brick or concrete-block foundation walls may be caused by improper back-filling, vibration from the movement of heavy equipment or vehicles close to the wall, or by the swelling or freezing and heaving of water-saturated soil adjacent to the wall.

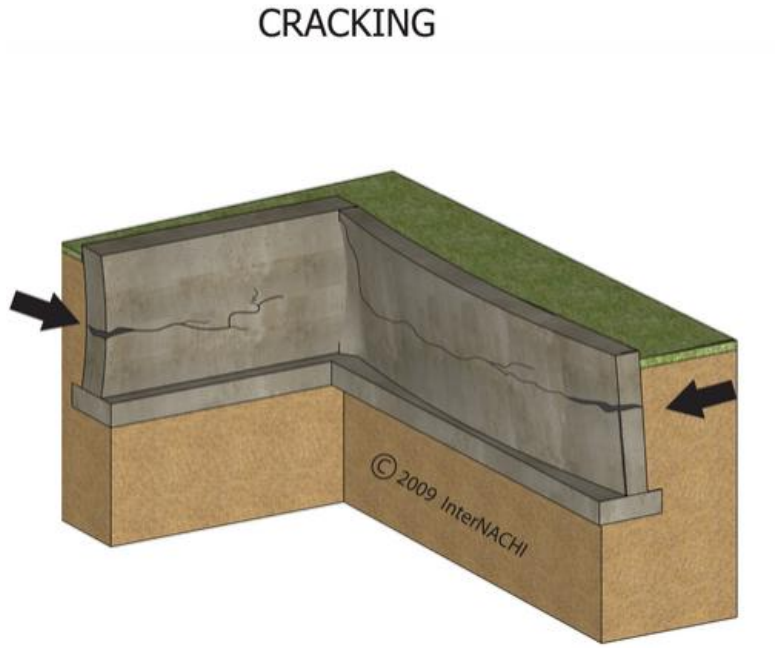
Similar to drying shrinkage, sweeping or horizontal cracking may have occurred during the original construction and been compensated for at that time. Such distress, however, is potentially serious, as it indicates that the vertical supporting member -- the foundation wall -- that is carrying a portion of the structure above is "bent" or "broken." It may be possible to push the wall back into place by careful jacking, and then reinforcing it with the addition of interior buttresses, or by pressure-injecting concrete epoxy grout into the wall. If outside ground conditions allow, the wall can be relieved of some lateral pressure by lowering the ground level around the building.



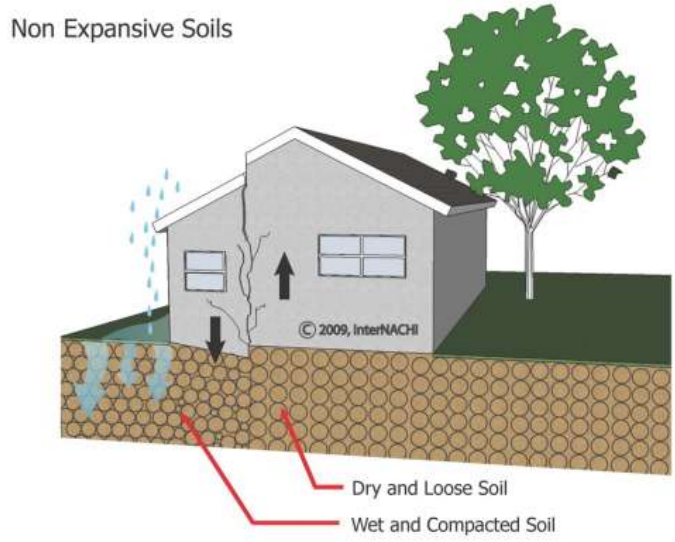
Soil

When expansive soils are suspected as the cause of the cracking, examine the exterior for sources of water, such as broken leaders or poor surface drainage.

If the damage is above the local frost depth, or if damage occurred during an especially cold period, the culprit may be frost-heaving.



17.5 Above-Ground



Masonry Walls

Brick Wall Cracking Associated with Thermal and Moisture Movement

Above-ground brick walls expand in warm weather, particularly if facing south or west, and contract in cool weather. This builds up stresses in the walls that may cause a variety of cracking patterns, depending on the configuration of the wall and the number and location of

openings. Such cracks are normally cyclical and will open and close with the season. They will grow wider in cold weather and narrower in hot weather.

Look for cracking at the corners of long walls, walls with abrupt changes in cross-section (such as at a row of windows), walls with abrupt turns or jogs, and in transitions from one- to two-story walls. These are the weak points that have the least capacity for stress.

Common moisture and thermal movement cracking includes:

- horizontal or diagonal cracks near the ground at piers in long walls due to horizontal shearing stresses between the upper wall and the wall where it enters the ground. The upper wall can thermally expand, but its movement at ground level is moderated by earth temperatures. Such cracks extend across the piers from one opening to another;
- along the line of least resistance. This condition is normally found only in walls of substantial length;
- vertical cracks near the end walls due to thermal movement. A contracting wall does not have the tensile strength to pull its end walls with it as it moves inward, causing it or the end walls to crack vertically where they meet;
- vertical cracks in short offsets and setbacks caused by the thermal expansion of the longer walls that are adjacent to them. The shorter walls are "bent" by this thermal movement and crack vertically;
- vertical cracks near the top and ends of the façade due to the thermal movement of the wall. This may indicate poorly bonded masonry. Cracks will tend to follow openings upward; and
- cracks around stone sills and lintels caused by the expansion of the masonry against both ends of a tight-fitting stone piece that cannot be compressed.

Cracks associated with thermal and moisture movement are usually only cosmetic problems. After their cause has been determined, they should be repaired with a flexible sealant, since filling such cyclic cracks with mortar will simply cause the masonry to crack in another location. Inspectors are not structural engineers. Cracks should be examined by a structural engineer.

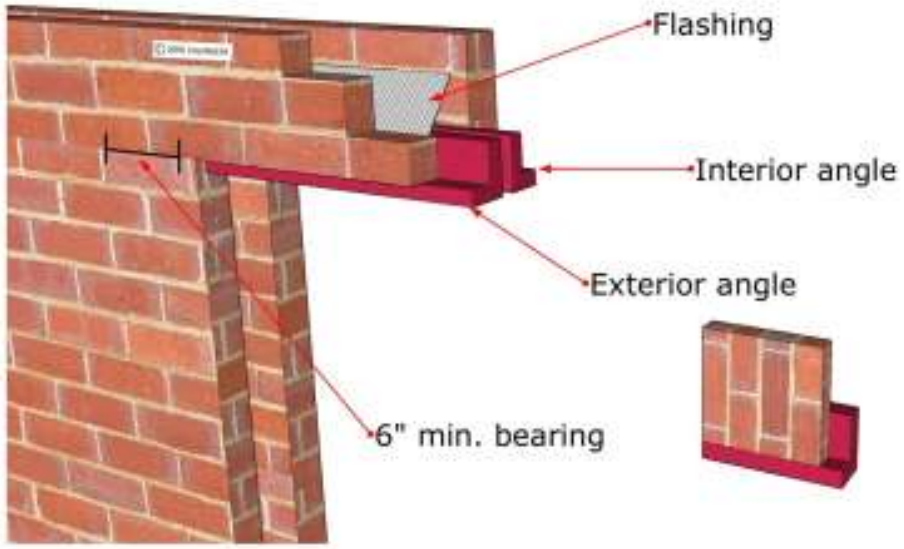
Brick Wall Cracking

Brick wall cracking can be associated with freeze-thaw cycles and corrosion. Brick walls often exhibit distress due to the expansion of freezing water, or the rusting of embedded metals.

Look for:

- cracking around sills, cornices, eaves, chimneys, parapets, and other elements subject to water penetration, which is usually due to the migration

of water into the masonry. The water expands upon freezing, breaking the bond between the mortar and the masonry and, eventually, displacing the masonry itself. The path of the water through the wall is indicated by the pattern of deterioration;



- cracking around iron or steel lintels, which is caused by the expansive force of corrosion that builds up on the surface of the metal. This exerts great pressure on the surrounding masonry and displaces it because corroded iron can expand to many times its original thickness. Structural iron and steel concealed within the masonry, if exposed to moisture, can also corrode and cause cracking and displacement of its masonry cover. Rust stains usually indicate that corrosion is the cause of the problem; and
- the joint between the masonry and a steel lintel that supports the masonry over an opening, to make sure it is clear and open. If the joint has been sealed, the sealant should be removed.

These conditions can usually be corrected by repairing or replacing corroded metal components and by repairing and re-pointing the masonry. Where cracking is

severe, portions of the wall may have to be reconstructed. Cracks should be further examined by a structural engineer.

Cracking and Structural Failure

Cracking or displacement of a wall may be associated with the structural failure of building elements. Structure-related problems, aside from those caused by differential settlement and earthquakes, are usually found over openings and, less commonly, under roof eaves and in areas of structural overloading.

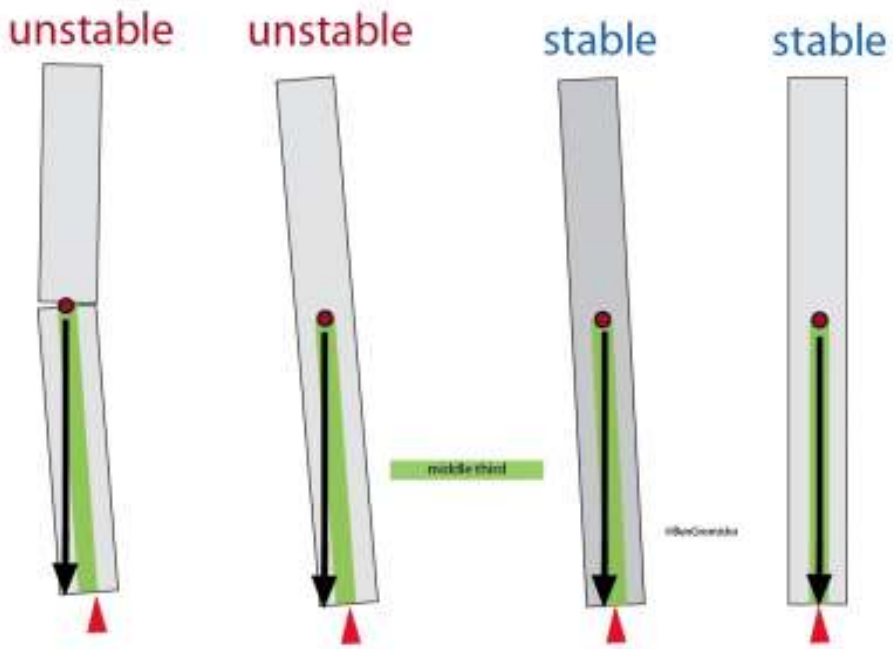
Such problems include:

- cracking or displacement of masonry over openings, resulting from the deflection or failure of the lintels or arches that span the openings. In older masonry walls with wood lintels, cracking will occur as the wood sags or decays. Iron and steel lintels also cause cracking as they deflect over time. Concrete and stone lintels occasionally bow and sometimes crack;
- masonry arches of brick or stone may crack or fail when there is wall movement, or when their mortar joints deteriorate. When such lintel deflections or arch failures occur, the masonry above may be supporting itself and will exhibit step cracks, beginning at the edges of the opening and joining in an inverted "V" above the opening's midpoint. Correcting such problems usually means replacing failed components and rebuilding the area above the opening;
- cracking or outward displacement under the eaves of a pitched roof due to failure in the horizontal roof ties that results in the roof spreading outward. The lateral thrust of the roof on the masonry wall may cause it to crack horizontally just below the eaves, or to move outward with the roof. The roof will probably be leaking, as well. When this occurs, examine the roof structure carefully to ascertain whether there is a tying failure. If so, additional horizontal ties or tension members will have to be added and, if possible, the roof pulled back into place. The damaged masonry can then be repaired. The weight also can be transferred to interior walls. Jacking of the ridge and rafters is possible, too; and
- masonry walls that sometimes show signs of bulging as they age. The wall itself may bulge, or the bulge may only be in the outer *wythe*. Bulging often develops so slowly that the masonry doesn't crack and, therefore, it may go unnoticed for a long period of time. The bulging of the whole wall is usually due to thermal or moisture expansion of the wall's outer surface, or to contraction of the inner *wythe*. This expansion is not completely reversible because once the wall and its associated structural components are pushed out of place, they can rarely be completely pulled back into their original positions.

Bulging of Walls

When wall bulges occur in solid masonry walls, the walls may be insufficiently tied to the structure, or their mortar may have lost its bond strength. Large bulges must be tied back to the structure; the star-shaped anchors on the exterior of masonry walls of many older buildings are examples of such ties. Check local building ordinances on their use. Small bulges in the outer masonry course often can be pinned to the inner course, or dismantled and rebuilt.

The effects of the cyclical expansion of a wall are cumulative and, after many years, the wall will show a detectable bulge. Inside the building, separation cracks



will develop on the inside face of the wall at floors, walls and ceilings. Bulging of only the outer masonry *wythe* is usually due to the same gradual process of thermal or moisture expansion; masonry debris accumulates behind the bulge and prevents the course from returning to its original position. In very old buildings, small wall bulges may result from the decay and collapse of an internal wood lintel or wood-

bonding course, which can cause the inner course to settle and the outer course to bulge outward.

Leaning of Walls

Masonry walls that lean represent an uncommon and serious condition that is usually caused by poor design and construction practices, particularly inadequate structural tying or poor foundation work.

Brick Veneer Walls

Brick veneer walls are subject to the forces of differential settlement, moisture- and thermal-related cracking, and the effects of freezing and corrosion.

Look for:

- cracks caused by frame shrinkage, which are most likely to be found around fixed openings where the independent movement of the veneer wall is restrained;
- bulging, which is caused by inadequate or deteriorated ties between the brick and the wall that it is held upon; and
- vertical cracking at corners or horizontal cracking near the ground caused by thermal movement of the wall, which is similar to that in solid masonry and masonry cavity walls, but possibly more pronounced in well-insulated buildings because of the reduction in the moderating effect from interior temperatures. Thermal cracks are cyclic and should be filled with a flexible sealant. Where there is severe cracking, expansion joints may have to be installed.

Problems Associated with Parapet Walls

Parapet walls often exhibit signs of distress and deterioration due to their full exposure to the weather, the splashing of water from the roof, differential movement, the lack of restraint by vertical loads or horizontal bracing, and the lack of adequate expansion joints.

At parapets, look for:

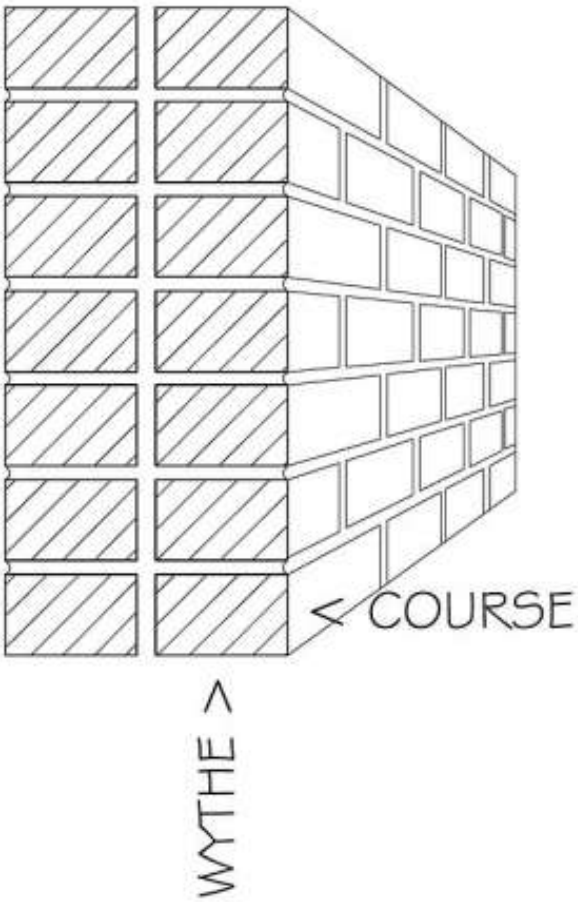
- horizontal cracking at the roof line due to differential thermal movement between the roof line and the wall below that is exposed to moderating interior temperatures. The parapet may eventually lose all bond except that from friction and its own weight, and may be pushed out by ice formation on the roof;
- bowing due to thermal and moisture expansion when the parapet is restrained from lengthwise expansion by end walls or adjacent buildings.

The wall will usually bow outward, since that is the direction of least resistance;

- overhanging the end walls when the parapet is not restrained on its ends. The problem is often the most severe when one end is restrained and the other is not;
- random vertical cracking near the center of the wall due to thermal contraction; and
- deterioration of parapet masonry due to excessive water penetration through inadequate coping or flashing, if any, which, when followed by freeze-thaw cycles, causes masonry spalling and mortar deterioration.

Fire Damage to Brick Masonry Walls

Masonry walls exposed to fire will resist damage in proportion to their thickness. Examine the texture and color of the masonry units, and probe their mortar. If they are intact and their basic color is unchanged, they can be considered serviceable. If they undergo a color change, consult a qualified structural engineer. Hollow masonry units should be examined for internal cracking, where possible, by cutting into the wall. Such units may need replacement if seriously damaged.



Brick Wythe

Above illustration made available by "Brick-terms-1" by Newell Post via Wikipedia

A *wythe* is a continuous vertical section

of masonry one unit in thickness. A wythe may be independent of, or interlocked with, the adjoining wythe(s). A single wythe of brick that is not structural in nature is referred to as a veneer.

A multiple-wythe masonry wall may be composed of a single type of masonry unit layered to increase its thickness and structural strength, or different masonry units chosen by function, such as an economical concrete block serving a structural purpose and a more expensive brick chosen for its appearance.

Quiz 11

T/F: A clean crack may indicate recent movement.

- True
- False

Mechanical damage can be caused by moisture entering the brick and freezing, resulting in _____ of the brick's outer layers.

- spalling
- leaching
- creeping
- swaying

_____ of brick or concrete-block foundation walls may be caused by improper back-filling, vibration from the movement of heavy equipment or vehicles close to the wall, or by the swelling and heaving of water-saturated dirt.

- Sweeping
- Spalling
- Mopping
- Corpsing

T/F: Structure-related problems, aside from those caused by differential settlement or earthquakes, are usually found over openings and, less commonly, under roof eaves or in areas of structural overloading.

- True
- False

Section 18: Eaves, Soffits and Fasciae

Eaves, Soffits and Fasciae

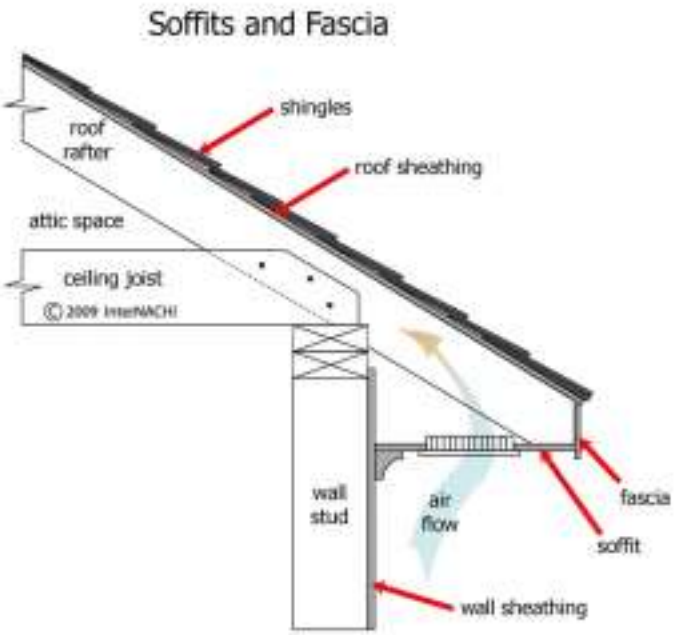
This section deals with the details of the eaves, soffit and fascia components of the house that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how the eaves, soffit and fascia function; and
- list some common concerns with the eaves, soffit and fascia.

The eaves refer to the edge of a roof that overhangs the exterior wall.

The soffit refers to the building material that forms a ceiling surface from the top of the exterior wall to the outer edge of the roof or fascia board, bridging the space between the siding and the roofline, otherwise known as the eaves.



The fascia refers to any horizontal surface that spans across the top of columns or across the top of a wall. The word fascia is derived from the Latin word for band or door frame. Specifically, it is used to describe the horizontal fascia board that caps the end of the roof rafters. The fascia can be used to hold the rain gutter. For a low-sloped roof, it is the border around the roof's perimeter.

The materials used at the soffits and fascia are made from wood, aluminum, fiber-cement, OSB, plywood and vinyl.

Many soffits have vents that allow air to flow into the unconditioned roof spaces. Vents installed on upper portions of the roof structure allow that air to continue to flow out of the roof space.

Inspection Tips

Look at the soffit and fascia from the ground level, as well as from a ladder. If you're using a ladder to get up on the roof's surface or to the roof's edge, that is an ideal time to inspect the soffit and fascia.

The fascia board is not readily visible when it is installed to support a rain gutter. When there is a drainage problem with the rain gutter, or if the roof is shedding water improperly, the fascia board is often deteriorated by moisture. Be sure to understand the limitations of your visual-only inspection of the eaves, and remember that there is a potential for concealed problems at the fascia board located behind the gutter.

When the soffit and fascia have been covered by aluminum or vinyl, there is a potential for concealed damage at these areas, as well. Damage could be covered up by the capping material. It is simply not possible to see everything.

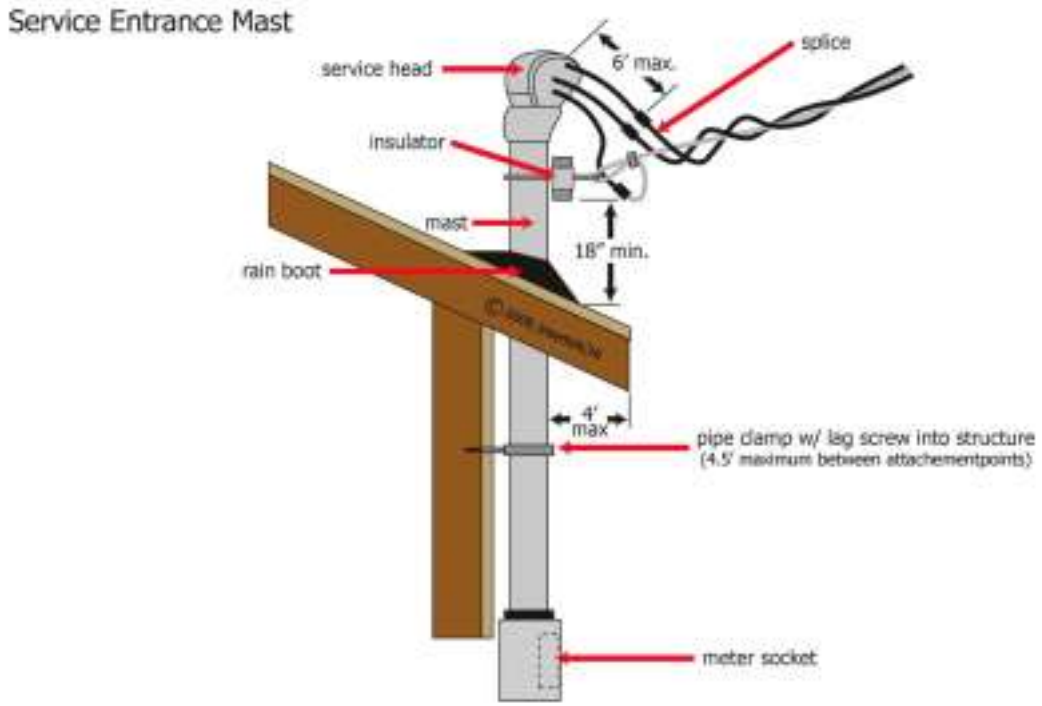
When you walk around the property, look up and inspect the eaves. It will be difficult to inspect when the house is two or three stories tall. Inform your client of your inspection's restrictions. Look for loose and missing sections. Look for water damage and water stains. Check the apparent attachment of the gutter to the fascia board. Look for peeling paint. Look for missing, blocked and damaged ventilation materials.

Wood rot at the soffit or fascia board may be caused by:

- roof leaks at the edge;
- roof penetrations that are causing leaks;
- drip edge problems;
- flashing leaks;
- ice dams;
- loose sections that are allowing water to penetrate; and
- overflowing gutters.

Be sure to check around the chimney flashing where the stack passes through the soffit. A leaking flashing at the chimney stack will cause water stains and water

damage in that area. Check anything that penetrates or passes through the roof and soffit, such as an electrical conduit or mast. Flashing problems are common at these areas.



Paint located at the eaves that is in poor condition may indicate a moisture problem. Peeling paint could be caused by normal failure with age and/or exposure to weather. So, be careful in your deductions.

High Winds

Aluminum and vinyl soffits are highly prone to failure when exposed to high winds. If the soffits fail, wind-driven rain can enter the area above the top of the wall and cause water intrusion problems. Loss of soffits can increase internal pressures and lead to loss of the roof sheathing and, eventually, building failure.

To perform adequately under high winds, soffits must be able to resist suction pressure (downward) and positive pressure (upward). Some building codes in certain geographical areas mandate that these areas be built to resist design-wind pressures.

Section 19: The Wall Assembly

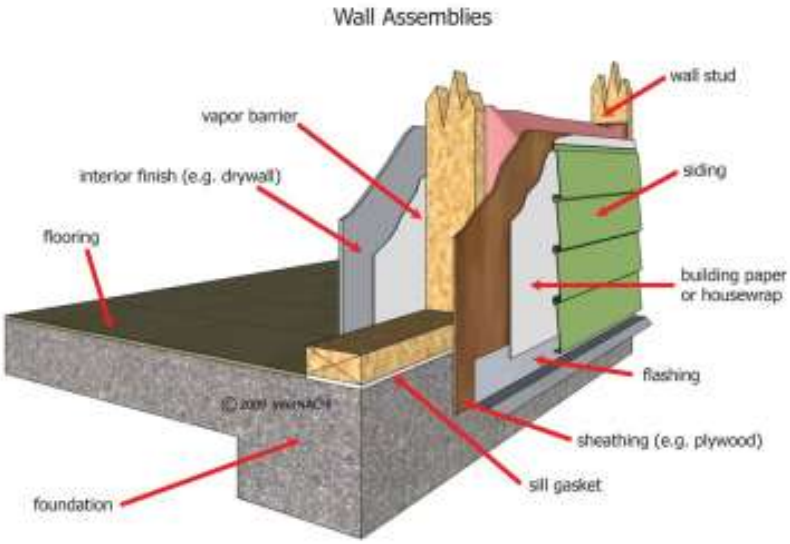
Wall Assembly

This section deals with the general terms and details of a typical wall assembly.

At the end of this section, you should be able to:

- list some of the components of a typical wall assembly; and
- describe the function of a WRB.

A typical wall assembly can be understood using the following illustration.



In a typical wall assembly, the following components may be present:

- wall studs or structural members;
- interior finish;
- insulation;
- air and/or vapor barrier;
- sheathing;
- building paper or housewrap;
- siding or exterior wall covering;
- flashing;

- flooring; and
- foundation.

The studs or structural members of the wall are usually not visible. They are the components of the wall that carry live and/or dead loads. They are designed to carry the floor load, roof load, the dead load from the siding, and the live load from the wind.

Interior finishes (drywall, plaster, or some other material) separate the interior from the exterior by restricting air movement through the wall.

Vapor barriers are installed according to building codes and practices of the local geographical area. In cold-winter climates, vapor barriers are generally installed on the interior-side of a wall assembly behind the interior finish.

Insulation is installed in between the structural members of a wood frame wall. Insulation can also be installed behind the siding, or behind the interior finish wall. The thickness of the insulation (or its R-value) and the type of insulation depend on the climate and the local building requirements. Home inspectors do not typically see the insulation inside a wall.

The purpose of sheathing installed on a wall is usually for adding strength. The typical building practice is to install the sheathing on the exterior side of the wall. The sheathing provides a substrate for wall components, such as the building paper. Sheathing may be plywood, OSB, wooden planks, fiberboard, exterior gypsum board, cement board, and insulation board. If rigid insulation boards or panels were installed, their primary function is to control heat energy.

Water-Resistive Barrier (WRB)

Structural components can be adversely affected by moisture. Due to the potential for water accumulation within a wall, a water-resistant membrane is required behind any exterior siding and veneer. Under certain conditions, asphalt felt or a similar water-resistant barrier is not necessary. It is permissible to eliminate the membrane in a detached building, and where the siding and finish materials provide the needed protection.

One layer of No. 15 asphalt felt or other approved water-resistive barrier, free from holes and breaks, should be applied over studs or sheathing of all exterior walls, behind the siding or veneer. The felt or material should be applied horizontally. The upper layer should overlap the lower layer a minimum of 2 inches. Where joints occur, the material should be lapped vertically at least 6 inches.

The functions of building felt paper include:

- providing a moisture-resistant barrier;
- providing a path for drainage; and
- allowing vapor to move through the wall from inside the house to the exterior.

In new construction, asphalt building felt paper is generally being replaced by the use of housewrap.

Section 20: Housewrap

Housewrap

In this section, the function of housewrap and its attributes are examined, and common problems associated with its use are reviewed.

Housewrap has two functions:

- to minimize air flow through a wall; and
- to stop and drain liquid water that has penetrated through the siding.

Housewrap is not a vapor retarder. It is designed to allow water vapor to pass through.

The choice to use housewrap or building paper depends on the climate and the preference of the installer/contactor or owner. Both materials can provide adequate protection.

Housewrap must be installed properly or it could be more detrimental than beneficial.

Proper installation, especially in lapping, is the key to employing housewrap successfully.

Housewrap serves as a dual-purpose weather barrier. It not only minimizes the flow of air in and out of a house, but it also stops liquid water and acts as a drainage

plane. Housewrap is not a vapor retarder. The unique characteristic of housewrap is that it allows water vapor to pass through it while blocking liquid water. This permits moist, humid air to escape from the interior of the home while preventing outside liquid water (in the form of rain) from entering the home.

Almost all exterior finishes allow at least some water penetration. If water continually soaks the wall sheathing and framing members, problems such as rot and mold growth could occur. Housewrap stops water that passes through the siding and allows it to drain away from the structural members.

Humid Climates

In humid climates with heavy rainfall, housewrap is recommended to prevent water damage to the framing. Its use in drier climates may not be as critical, since materials are allowed to adequately dry, although housewrap also prevents air movement through the wall cavity, which is beneficial for insulating purposes.

Housewrap vs. Building Paper

It is important to know what attributes are most important for a particular climate. Five attributes associated with secondary weather barriers are:

- air permeability, which is the ability to allow air to pass through;
- vapor permeability, which is the ability to allow water vapor (gaseous water) to pass through;
- water resistance, which is the ability to prevent liquid water from passing through;
- moisture-repellent, which is the ability to prevent moisture absorption; and
- durability, which is the resistance to tearing and deterioration.

As shown in the table (next page) the climate where the house is located determines the importance of the attribute.

Rule of Thumb

It is important to remember one rule of thumb related to the transport of moisture vapor in walls. Namely, any vapor retarder must be located on the warm-in-winter side of the wall (inside) in all climates, except hot/humid climates where it should be placed on the warm-in-summer side of the wall (outside), if one is used at all.

Housewrap Installation

No matter what product is used (housewrap or building paper), neither will work effectively if not installed correctly. In fact, installing housewrap incorrectly could do more harm than not using it at all. Housewrap is often thought of and installed as

ATTRIBUTE	CLIMATIC CONDITIONS	BUILDING PAPER PERFORMANCE	HOUSEWRAP PERFORMANCE
water resistance	windy and rainy	good	excellent
vapor permeability	hot and humid	fair	good
air permeability	windy and cold	fair	good
moisture-repellent	high rainfall	good	excellent
durability	windy, with exposure to weather	fair	good

if it were just an air retarder. But a housewrap will channel water and collect it whether the installer intends it to or not. This can lead to serious water damage if the housewrap is installed in a manner that does not allow the channeled water to exit out of the wall system.

Inspection Tips for Housewrap

The following are inspection tips for checking successful installation of housewrap at new construction:

- manufacturers' instructions are followed;
- the housewrap is installed before the windows and doors are installed;
- the upper layer is lapped over the lower layer;
- horizontal joints are lapped at least 6 inches;
- vertical joints are lapped 6 to 12 inches, depending on potential wind-driven rain conditions;
- 1-inch minimum staples or roofing nails are used and spaced 12 to 18 inches on-center throughout;
- joints are taped with housewrap tape;
- a drainage provision is installed at the bottom of the siding;
- the housewrap is extended over the sill plate and foundation joint; and
- the housewrap is installed such that water will never be allowed to flow to the inside of the wrap.

Inspect for These Common Problems

- incomplete wrapping:
  Gable ends are often left unwrapped, leaving a seam at the low end of the gable. This method works to prevent air intrusion, but water that gets past the siding will run down the unwrapped gable end and get behind the housewrap at the seam. Also, it is common for builders to pre-wrap a wall before standing it. If this is done, the band joist is left unwrapped. The band joist can be wrapped by inserting a strip 6 to 12 inches underneath the bottom edge of the wall wrap. In addition, outside corners are often missed.

- improper lapping:
  This often occurs because the housewrap is thought of as an air retarder alone. When applying the housewrap, keep in mind that it will be used as a vertical drainage plane, just like the siding.

- doors and windows:
  Improper integration with flashing around doors and windows can create moisture intrusion problems.

Quiz 12

T/F: One function of housewrap is to minimize air flow through a wall.

- True

- False

T/F: One function of housewrap is to allow liquid water to penetrate.

- False
- True

T/F: Housewrap is designed to prevent water vapor from passing through.

- False
- True

T/F: When installing housewrap, the lower layer should always be lapped over the upper layer.

- False
- True

T/F: Housewrap joints should be taped with housewrap tape.

- True
- False

Section 21: Waterproofing and Damp-Proofing

Waterproofing and Damp-Proofing

This section deals with the waterproofing and damp-proofing that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe the functions of waterproofing and damp-proofing; and
- describe the differences between the two.

Waterproofing and damp-proofing both relate to moisture protection. They are often misapplied and incorrectly used by inspectors. The term waterproofing is often used when damp-proofing is really meant. Damp-proofing does not provide the same degree of moisture protection as waterproofing.

Building codes typically require damp-proofing of foundation walls that retain earth

and enclose interior spaces and floors below grade. Damp-proofing should be applied from the top of the footing to the finished grade.

Damp-proofing for masonry walls involves applying a Portland cement parging to the exterior of the wall.

The parging should be damp-proofed by one of the following:

- bituminous coating;
- acrylic-modified cement;
- surface-bonding cement;
- a permitted waterproofing material; or
- other approved methods or materials.

The use of waterproofing measures is reserved for conditions where a high water table or other severe soil-water conditions are known to exist. Strictly speaking, waterproof does not mean watertight, as with a boat hull. It simply involves the application of a more impermeable membrane on the foundation wall.

With some exceptions, walls should be waterproofed using one of the following materials:

- 2-ply hot-mopped felt;
- 55-pound roll roofing;
- 6-mil polyvinyl chloride;
- 6-mil polyethylene;
- 40-mil polymer-modified asphalt;
- 60-mil flexible polymer cement;
- 1/8-inch cement-based, fiber-reinforced waterproofing coating; or
- 60-mil solvent-free, liquid-applied synthetic rubber.

6-Mil Polyethylene Sheet

The use of 6-mil poly as a waterproofing membrane on basement foundations helps to bridge small cracks, and also minimizes the rate of moisture transport through

the foundation wall by means of capillary action and vapor transmission. These sources of moisture transport add to moisture levels inside the basement and above-grade portions of the home. In an NAHB survey of foundation construction practices and moisture-related problems, basement walls with a 6-mil poly covering were 11 times less likely to experience leakage problems compared to typical damp-proofing.

Best Practices

The waterproofing method is recommended as a best practice, especially if the basement is intended to be used for storage or living space. Waterproofing may involve the simple application of damp-proofing, plus a layer of 6-mil poly on the exterior below-grade portions of a basement foundation wall. Other single-ply or built-up membranes may also be used.

Damp-proofing is the application of one or more coating of impervious compounds to prevent the passage of water vapor through walls under slight pressure.

Waterproofing is the application of a combination of sealing materials and impervious coatings to prevent the passage of moisture in either a vapor or liquid form under conditions of significant hydrostatic pressure.

Parging

A concrete parge coat is a thin coat of a cementitious mortar applied to a masonry surface. A typical parge coat is 1/16-inch to 1/4-inch thick. The parge coat can be applied to a foundation wall. Concrete block walls are typically parge-coated before a bituminous damp-proofing coat is applied. The parging provides a smooth surface for the damp-proofing material. Poured concrete foundation walls are smooth enough that they typically do not require a parge coat.

Inspection Tip

At the top of the foundation wall that is exposed, you may see the top of the parge coat or the top edge of the black-colored bituminous damp-proofing. The parge coat is not the damp-proofing feature but is the surface upon which the damp-proofing is applied.

Section 22: Permanent Wood Foundations

Permanent Wood Foundations

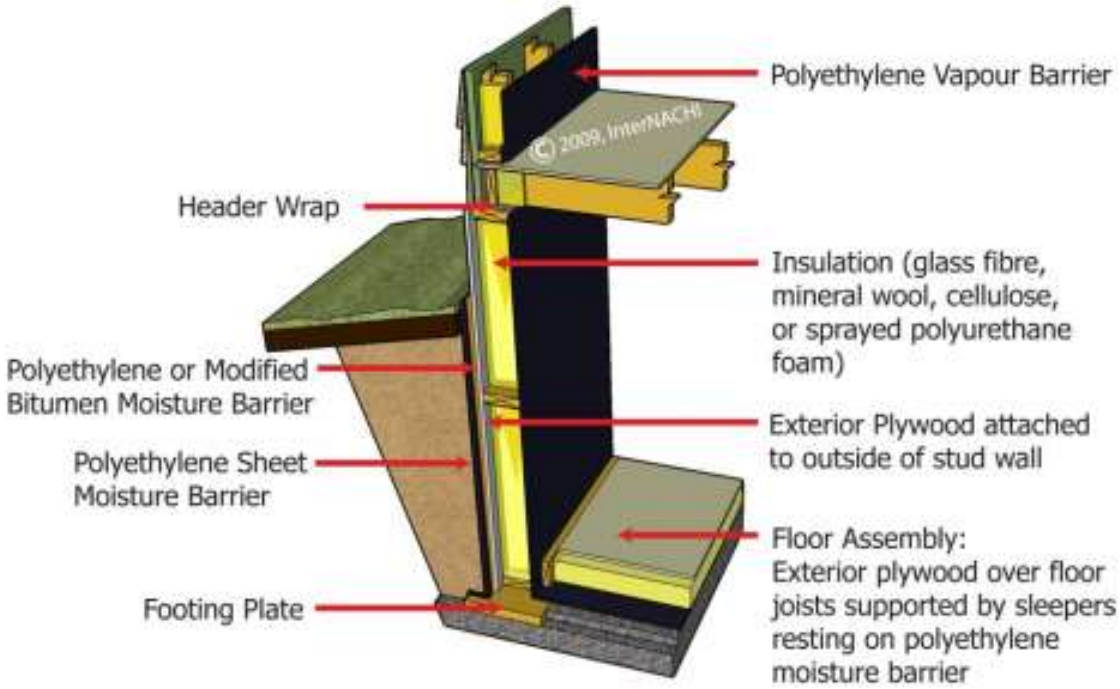
This section deals with the details of permanent wood foundations that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how a permanent wood foundation functions; and
- list some common concerns with permanent wood foundations.

While traditional basement walls are made from masonry materials, such as concrete and stone, inspectors should be prepared to encounter permanent wood foundations (PWFs). When pressure-treated wood was developed in the 1960s, it became possible for wood to be used in foundation walls without being prohibitively vulnerable to damage from insects and moisture. By the 1970s, PWFs gained wide acceptance.

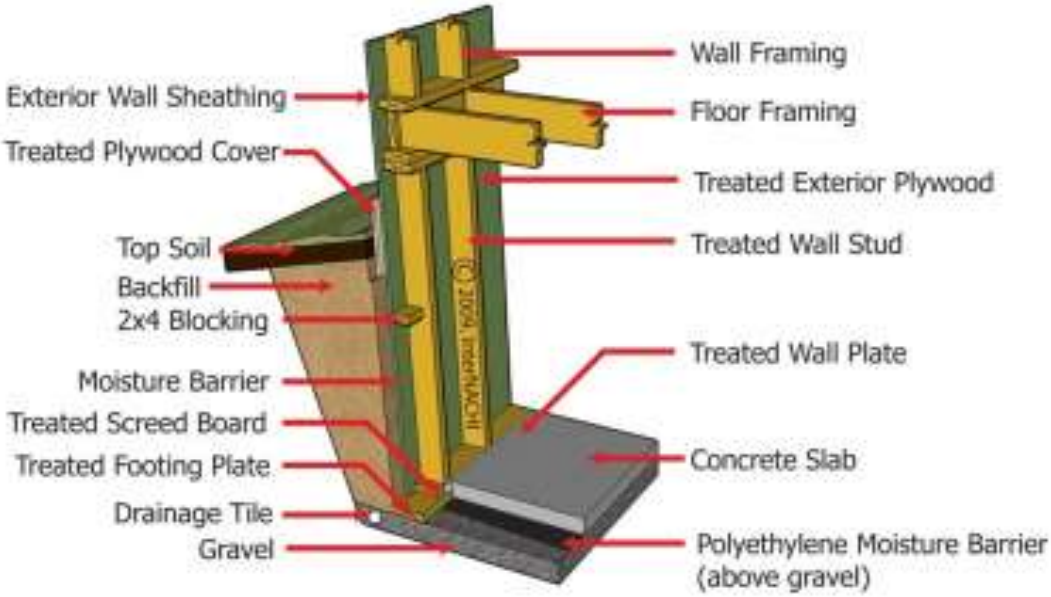
Common Configuration for Permanent Wood Foundation



Some builders and manufacturers claim that wood foundations offer a number of advantages over masonry foundations, including the following.

- Wood foundations are simpler, quicker and cheaper to construct than masonry foundations. However, they don't last as long as masonry foundations, and are less durable in the long term.
- The design of PWFs requires that dry soil be maintained around the foundation. This means that a properly constructed and maintained basement with wood walls will remain dry and mildew-free. Basement mildew, leakage and dampness are common in houses with masonry foundations.
- Finishing a basement is easier when walls are made from wood. Insulation is placed between the wall studs to which drywall can be attached.
- The basement will be warmer because wood is a better insulator than masonry, and the foundation wall studs provide large cavities for insulation. However, wood foundation walls are typically much thinner than masonry walls. Also, masonry can be insulated.

Perserved Wood Foundation



Inspectors can check for the following indicators that wood basement walls are experiencing problems.

- If dampness is present, its source should be identified. Dampness may be due to a rising water table, an inadequate drainage system, or inadequate damp-proofing. Water from an interior source, such as an air conditioner or a high-efficiency furnace, does not indicate a compromised PWF.

- Inspectors can check for exterior wood decay by probing the wall from the outside with a rod. It is usually adequate to probe at every 8 feet. If decayed wood is detected by probing, it is likely that decay exists elsewhere in the wall.
- If the interior wall is not covered by drywall, it may be possible to inspect for wood decay below grade from the inside of the house.
- Evidence of foundation leakage may be discovered at butt joints where sealant may not have been used.
- Buckling can occur due to constant pressure over the course of years, or by the back-filling process.
- Outside, a moisture barrier should be present and it should rise above grade.
- The foundation walls may be bowed, especially at the wall next to the basement stairs.

Damp-Proofing

PWFs rely on adequate damp-proofing. Inspectors can refer to the 2006 International Residential Code (IRC) for specifics regarding this subject.

Plywood panel joints in the foundation walls should be sealed their full length with a caulking compound capable of producing a moisture-proof seal under the conditions of temperature and moisture content appropriate for their installation.

A 6-mil-thick (0.15mm) polyethylene film should be applied over the below-grade portion of exterior foundation walls prior to backfilling. Joints in the polyethylene film should be lapped 6 inches (152mm) and sealed with adhesive. The top ledge of the polyethylene film should be bonded to the sheathing to form a seal. Film areas at grade should be protected from mechanical damage and exposure by a pressure preservative-treated lumber or plywood strip attached to the wall several inches above finish-grade level, and extending approximately 9 inches (229mm) below grade. The joint between the strip and the wall should be caulked full-length prior to fastening the strip to the wall. Other coverings appropriate to the architectural treatment may also be used. The polyethylene film should extend down to the bottom of the wood footing plate, but should not overlap or extend into the gravel or crushed-stone footing.

In summary, permanent wood foundations are relatively new and somewhat rare, but inspectors should know the defects that are commonly associated with them.

Section 23: Common Problems with Walls

23.0 Common Problems with Walls

Certain problems and concerns are common to all walls and siding installations.

This section covers the following issues with walls, including:

- inadequate clearance from the ground surface;
- inadequate clearance from the roof cover;
- dense vegetation;
- wood and soil contact; and
- water intrusion.

23.1 Inadequate Clearance from the Ground

There should be adequate clearance from the ground to the bottom of the siding. Generally speaking, there should be 6 to 8 inches of clearance. Some of the foundation wall should be visible above the ground surface and below the siding. Homeowners may not like the appearance of the exposed foundation, but that area should not be covered up with siding. Siding should extend over the top of the foundation wall to protect that area of the structure. If the siding is 8 inches above the ground surface, then the top of the foundation should be at least 9 to 10 inches above the ground surface.

Brick may be found below grade and that may be acceptable, depending on the type of brick. In some cases, the brick may be designed for use underground. If the brick was designed to be underground, then there should not be major deterioration or water damage found.

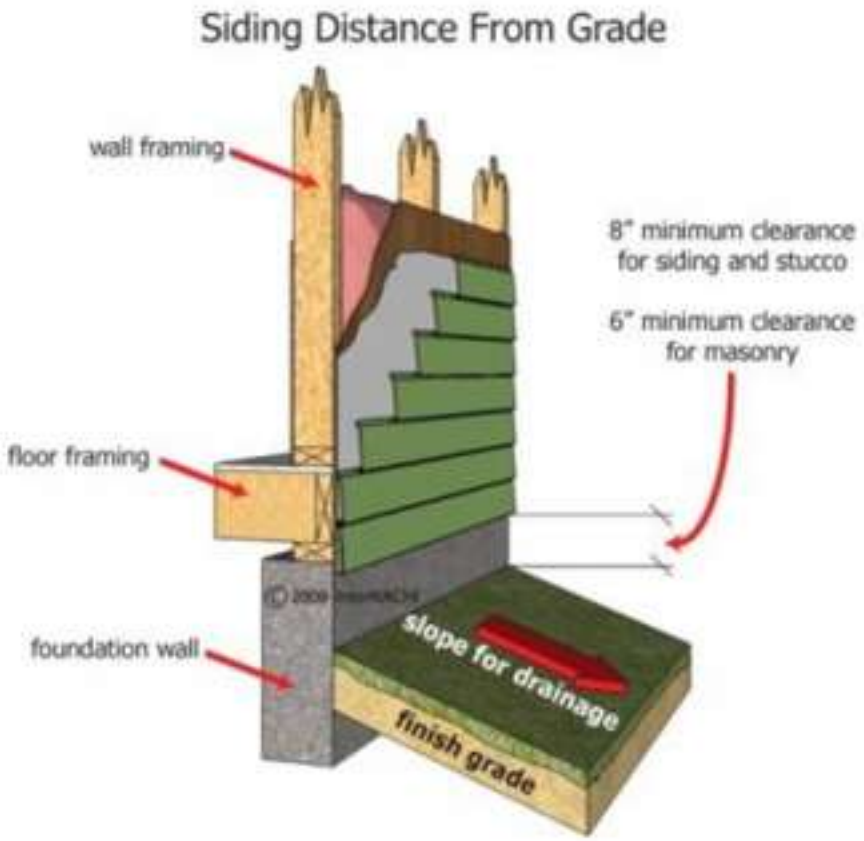
Most other sidings, including wood, stucco, fiber-cement, metal, vinyl, and wood-based siding, should have adequate clearance from the ground.

Damage from inadequate clearance may include:

- wood rot;
- rust;
- staining;
- clogged or restricted drainage provisions;

- water-damaged wood siding; and
- deteriorated paint.

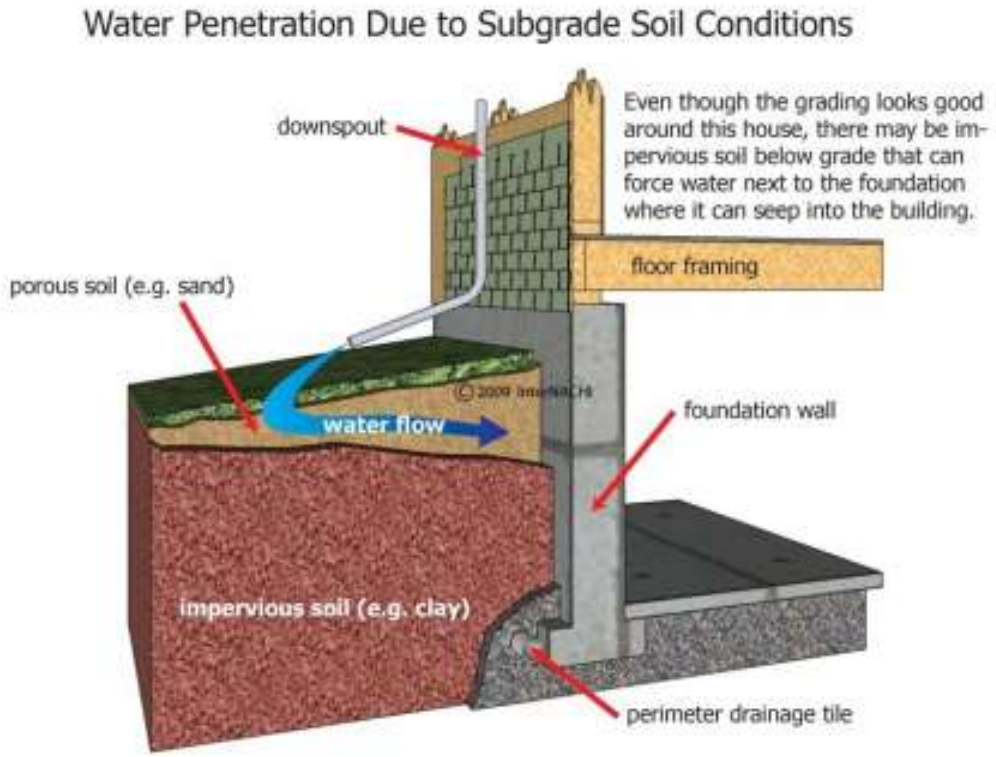
Major problems may occur if the drainage provisions are clogged or restricted. If the moisture drainage provisions of an EIFS are below grade, then the system will not function properly. Water will not be able to drain out of the siding system. Water may enter the structure through the weep or drainage holes. Major water damage, such as spalling to masonry brick siding, may occur.



Inside the house, major damage may be found when the drainage provisions of the siding are below grade. Wood rot, water intrusion, and insect infestation may be found at the sill plate, floor joist ends, sheathing, and stud walls.

Inspection Tips

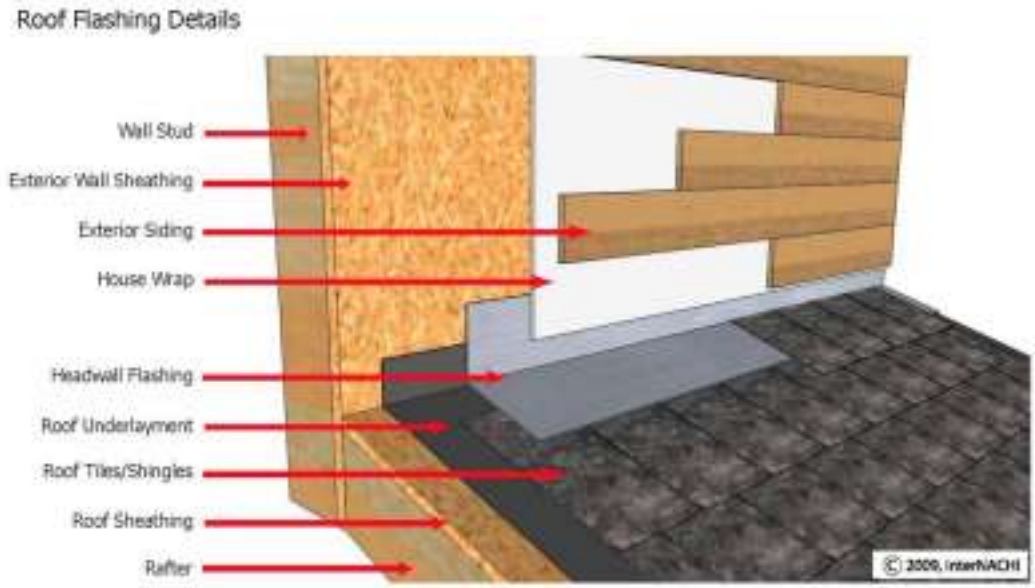
As you walk around the exterior, look closely at the overall grading, the slope of the ground nearest the house structure, and the distance between the siding and the ground surface. Pay attention to the exposed foundation. Check to see whether at least 6 inches of exposed foundation is visible all around the perimeter of the structure. If you see any contact between the siding and the ground, move in closer to inspect using a probe and a moisture meter. Check for water damage at the siding material. Look for drainage provisions.

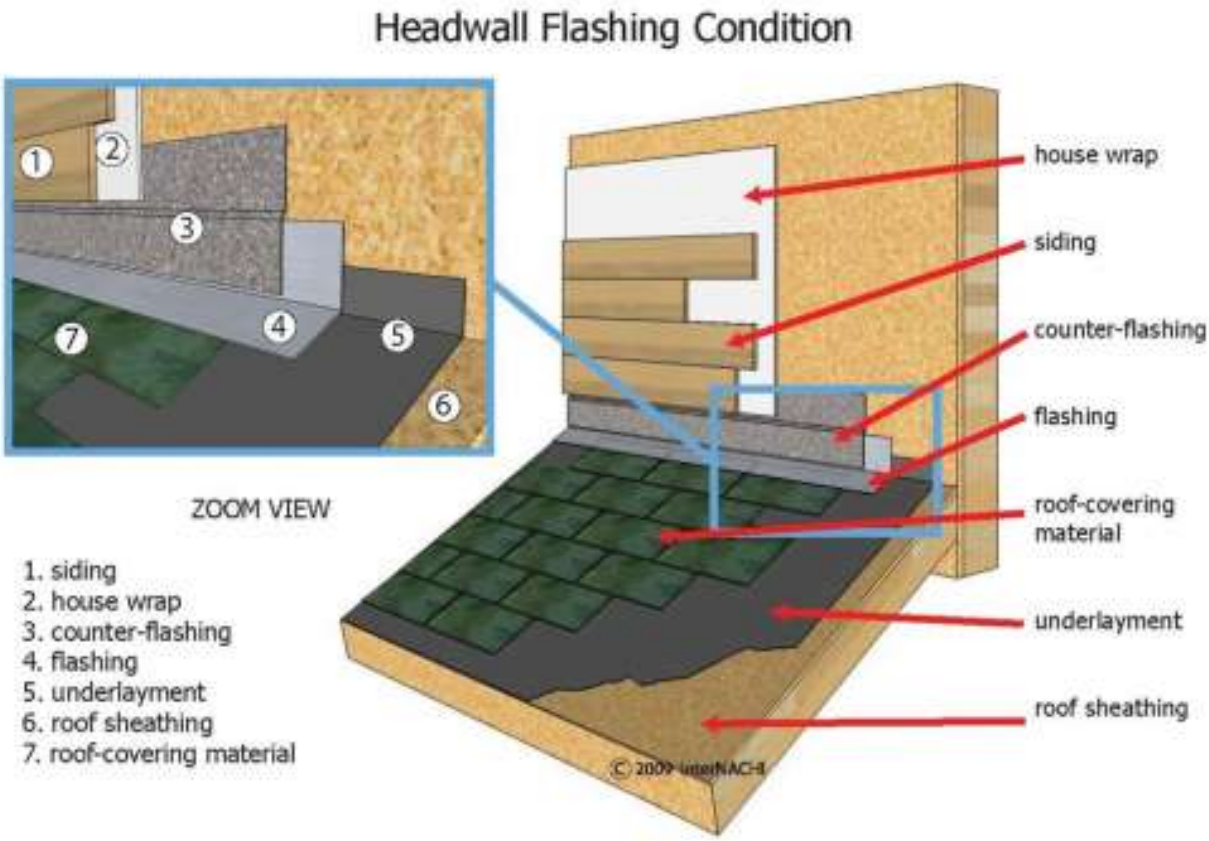


Oftentimes, a property owner will add dirt or landscaping materials up against the siding to cover the exposed foundation. Maybe the property owner was doing some landscape work, or the original grading was simply poorly done. Whatever the reason, there should be adequate clearance between the bottom of the siding and the ground surface to prevent major damage to the siding and water intrusion into the structure.

23.2 Inadequate Clearance from the Roof Cover

The best building practice is to have some distance or clearance between the bottom of the siding and the roof surface. The siding, no matter what type of material, should not come into contact with the roof-covering material. In general, you





should find at least 1 inch of clearance during your inspection. With adequate clearance installed, you may be able to confirm the type, condition, and proper installation of flashing at the roof-wall intersection.

Wood siding is particularly vulnerable to moisture damage. Wood siding in contact with a roof's surface will wick moisture. End grains of wood and cut edges of wood siding, particularly plywood siding, can easily absorb or wick moisture.

Inspection Tips

Look for at least an inch of clearance. If you are walking on the roof, it may be easy to kneel down to get a better look at the bottom of the siding. Use your hand to feel the condition of the siding along the roof surface. Sometimes, pushing on the siding may reveal concerns about the condition of that roof-wall intersection. If there is no clearance at that roof area, then probe for damage and use a moisture meter.

If the siding is damaged, water may penetrate the exterior covering and enter the structure. Adequate clearance between the siding and roof surface is essential.

23.3 Dense Vegetation

Some vines and ivy grow on structures. Some do damage and some don't. Some cause cosmetic problems when they are pulled off the house and removed. All vines and ivy tend to hold moisture up against the house siding. They provide paths for water intrusion into the structure. They provide paths for insects to enter the house. Vines can move the siding, loosen fasteners, and cause separations and openings in the exterior covering.

Vines should be kept off of wood siding, away from trim and flashing, off of soffits and fascia, and clear from gutter and downspout systems. Vines should be prevented from growing on and under siding, particularly aluminum.

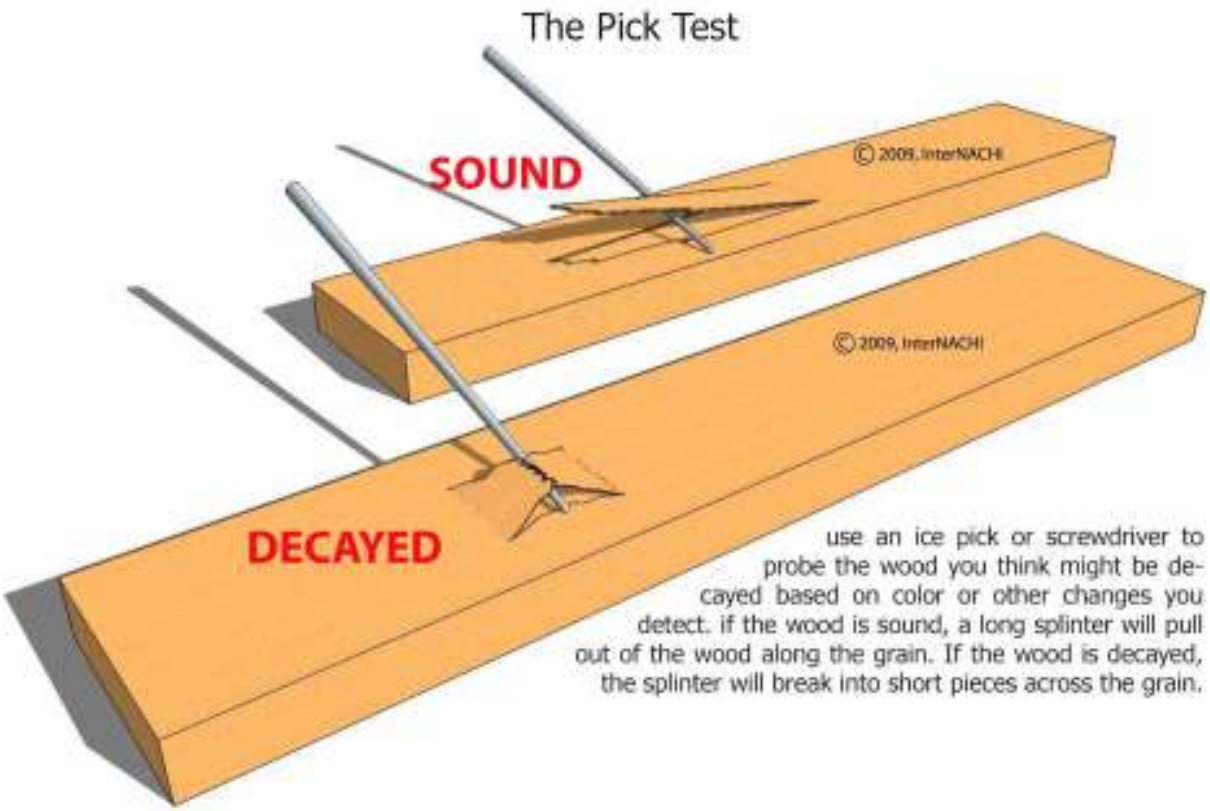
Dense vegetation with vines and ivy is an inspection restriction. The wall covering may not be completely inspected because of the vegetation. Access to components on the outside of the house may be restricted physically, as well as visually. This

type of restriction should be noted in an inspection report.

23.4 Wood and Soil Contact

Wooden components that are close to the ground are vulnerable to moisture damage. Siding, as well as all unprotected wooden components, should have adequate clearance above the ground surface. The wood around window wells, crawlspace access doors, basement doors, decks, porches, stairs, ramps, carports, detached garages, wooden railings and balconies are all susceptible to deterioration as a result of wood and soil contact.

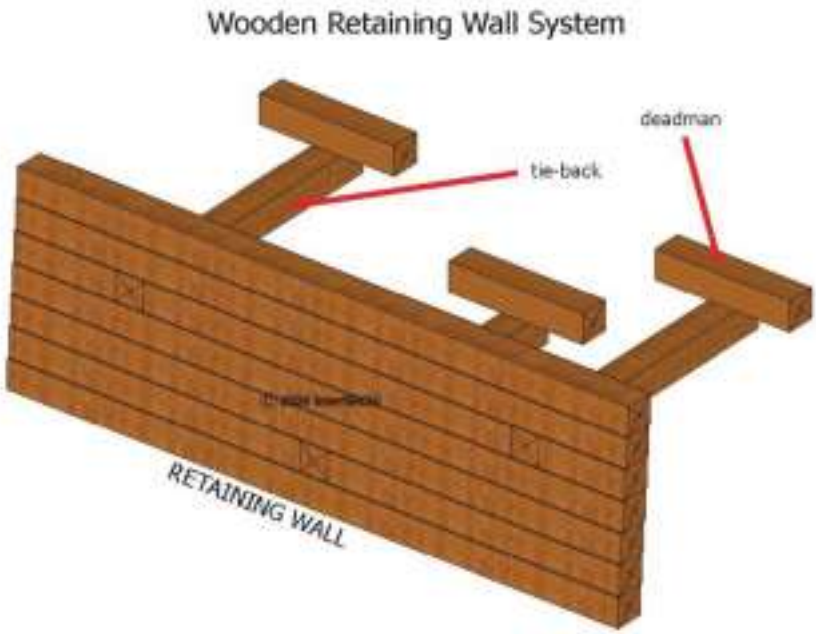
Wood and soil contact is commonly found by inspectors at detached garages. The bottom plate of the stud wall of the detached garage is commonly found to be installed under the surface of the ground level. The bottom plate is sometimes covered by the poured concrete floor of the garage and buried, so it is not readily visible. If the bottom plate is accessible, you could probe or knock on it with a screwdriver or some type of pointed instrument. The plate should sound and feel solid and in good condition.



A pick test uses as instrument to probe the wood you think might be decayed based on color or other changes you detect. If the wood is sound, a long splinter will pull

out of the wood along the grain. If the wood is decayed, the splinter will break into short pieces across the grain.

The bottom of the load-bearing posts at carport structures is often deteriorated because of inadequate clearance between the bottom of the posts and the ground.



Retaining walls made of wood are often found to be deteriorated because they are in contact with the ground.

Planter boxes that are installed against the side of a house cause problems related to wooden components in contact with soil.

Inspection Tips

Places to look for wood and soil contact include:

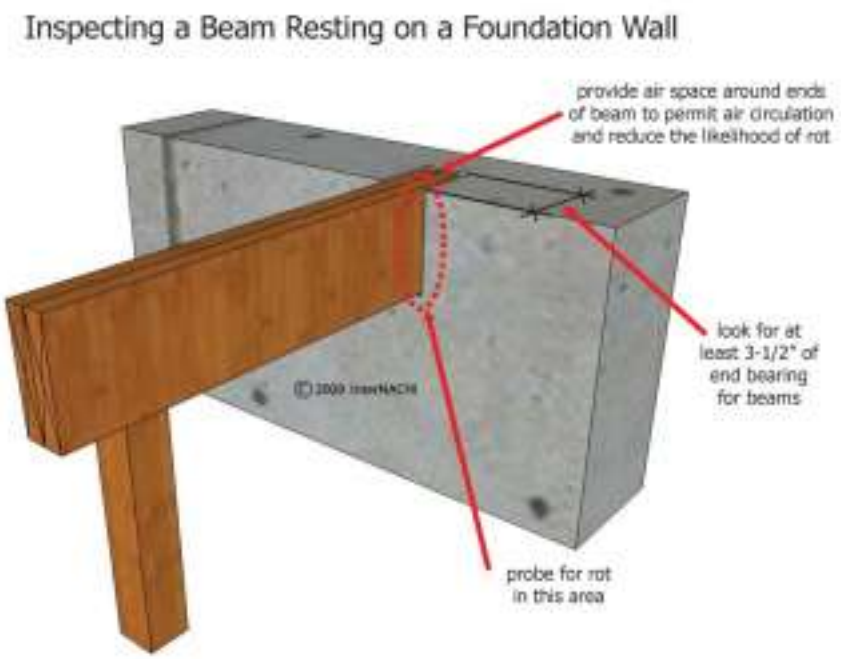
- the bottom of the siding;
- where the foundation meets a wooden structure;

- the bottoms of doors;
- window sills and jambs;
- window wells;
- crawlspace access panels;
- retaining walls;
- outdoor planters;
- carports;
- detached garages;
- porch, deck and balcony support posts;
- the bottom of wooden railing posts; and
- the bottom of wooden exterior stairs.

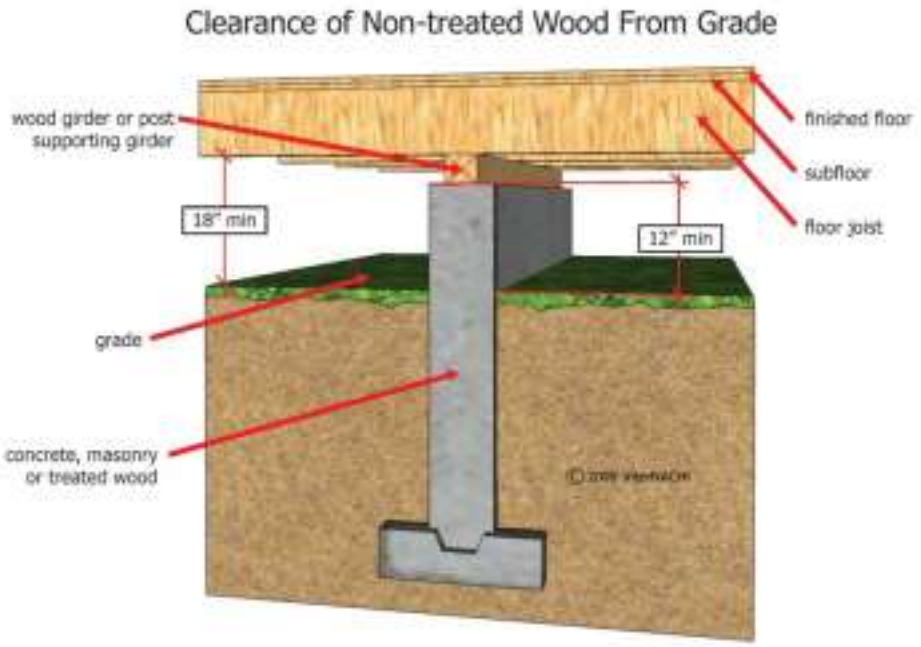
Protection Against Decay

Protection from decay should be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated:

- wood joists closer than 18 inches, or wood girders closer than 12 inches to exposed ground in crawlspaces or unexcavated areas located within the building foundation's perimeter;
- all wood framing members that rest on concrete or masonry exterior foundation walls and are less than 8 inches from exposed ground;
- sills and sleepers on a concrete slab that is in direct contact with the ground;
- ends of wood beams entering masonry walls having clearances less than ½-inch all around; and
- wood siding, sheathing, and wall framing components on the exterior having clearances less than 6 inches from the ground.



For those areas of a house that are subject to decay, the lumber must be pressure preservative-treated or of a wood species having a natural resistance to decay. Such naturally durable wood includes the heartwood of decay-resistant redwood, cedar, black locust, and black walnut.



Crawlspaces and unexcavated areas under a house will usually contain moisture-laden air. The foundation walls and the concrete floor of a slab-on-grade foundation will absorb moisture from the ground and, by capillary action, will move it to wooden framing components with which they are in contact. Damage to the wood could be possible unless adequate clearance is maintained or the appropriate building material is used.

All structural, load-bearing wood members in contact with the ground should be suitable for ground-contact use. Lumber or plywood required to be pressure preservative-treated should have the quality mark of an approved agency.

Wood Rot

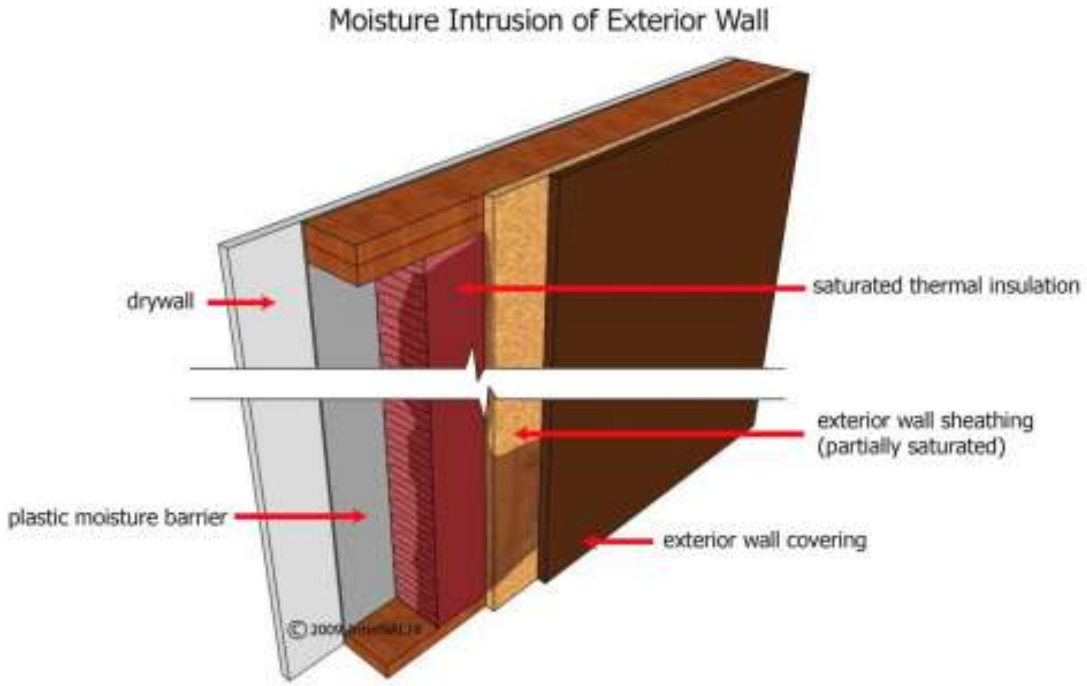
Wood rot may be easily overlooked. Rot or water damage may have been patched quickly and painted over prior to your inspection. Without close observation or physically touching the damaged component, wood rot or water damage may be missed during your inspection. Inspectors often use their fingers or thumb to press on the suspect components to check for damage and rot. Be very careful when using a screwdriver or probe while inspecting windows and doors. You do not want to create more problems than actually exist.

23.5 Water Intrusion

To be able to inspect for moisture intrusion and related problems, an inspector should understand the basics of how moisture can move through a house.

Moisture and water vapor move in and out of a house in three ways:

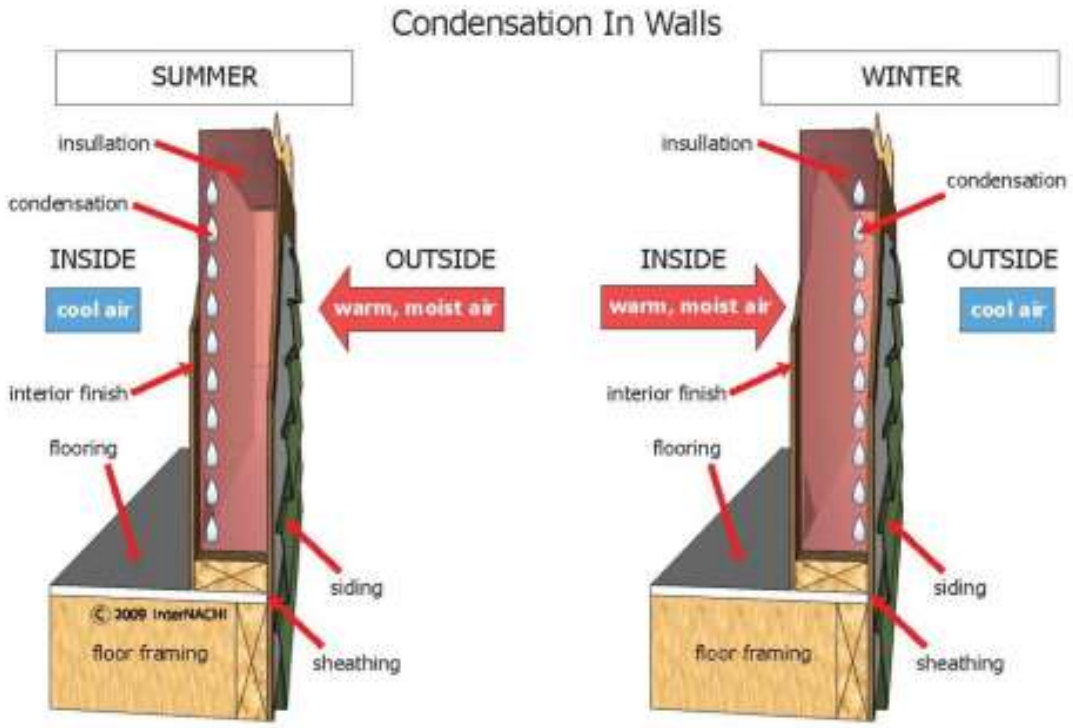
- with air currents;
- by diffusion through building materials; and
- by heat transfer.



Of these three, air movement accounts for more than 98% of all water vapor movement in building cavities. Air naturally moves from a high-pressure area to a lower one by the easiest path possible — generally, through any available hole or crack in the building envelope. Moisture transfer by air currents is very fast -- in the

range of several hundred cubic feet of air per minute. Thus, to control air movement, a house should have any unintended air paths carefully and permanently sealed.

The other two driving forces — diffusion through building materials and heat transfer — are much slower processes. Most common building materials slow moisture diffusion to a large degree, although they never stop it completely. Insulation also helps reduce heat transfer or flow.



The laws of physics govern how moist air reacts within various temperature conditions. The study of moist air properties is technically referred to as psychrometrics. A psychrometric chart is used by professionals to determine at what temperature and moisture concentration water vapor begins to condense. This is called the dew point. By understanding how to find the dew point, you will better understand how to diagnose moisture problems in a house.

Relative humidity (RH) refers to the amount of moisture contained in a quantity of air compared to the maximum amount of moisture that the air could hold at the same temperature. As air warms, its ability to hold water vapor increases; this

capacity decreases as air cools. For example, according to the psychrometric chart, air at 68º F (20º C) with 0.216 ounces of water (H_2O) per pound of air (14.8g H_2O ÷ kg air) has a 100% RH. The same air at 59º F (15º C) reaches 100% RH with only 0.156 ounces of water per pound of air (10.7g H_2O ÷ kg air). The colder air holds about 28% of the moisture that the warmer air does. The moisture that the air can no longer hold condenses on the first cold surface it encounters (the dew point). If this surface is within an exterior wall cavity, the result will be wet insulation and framing.

In addition to air movement, the temperature and moisture content can also be controlled. Since insulation reduces heat transfer or flow, it also moderates the effect of temperature across the building envelope's cavity. In most U.S. climates, properly installed vapor-diffusion retarders can be used to reduce the amount of moisture transfer. Except in deliberately ventilated spaces, such as attics, insulation and vapor-diffusion retarders work together to reduce the opportunity for condensation to form and accumulate in a house's ceilings, walls and floors.

No wall is 100% waterproof, especially considering that there will be wall openings and penetrations that compromise the siding materials. If caulk is used as a primary barrier to moisture penetration through openings, it should be checked during an inspection. Flashing should be installed in the appropriate areas.

Inspection Tips

Look at the exterior siding for obvious water damage and signs of deterioration. You won't be able to tell much about water intrusion by looking at certain siding materials, such as vinyl and aluminum. But wood siding may offer clues as to the condition of the wall and the possibility of moisture intrusion. If the siding is deteriorating, that may be a good indication of some damage behind it. Look closely at the siding and try to determine where liquid water may penetrate the siding. Look for large openings where air may enter walls through the siding. When you are inside, look for indications of water intrusion. Water intrusion does not always show up on the building's interior.

Section 24: The Flashing of Wall Components & Moisture Problems

24.0 The Flashing of Wall Components

This section deals with the details of the flashing of wall components and related moisture problems that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe the locations where flashing should be installed;
- list some common concerns with flashing around windows, doors and ledgers;
- list important features of flashing and caulking; and
- describe the function of kick-out or diverter flashing.

Water penetration and accumulation in walls are most commonly associated with flashing and detailing problems around windows, doors, and other penetrations through the weather-resistant wall envelope. This section explains recommended flashing details for common applications in residential construction.

These points are intended to enhance or help fulfill the basic objective for flashing of the weather-resistant wall envelope, as found in the 2006 IRC:

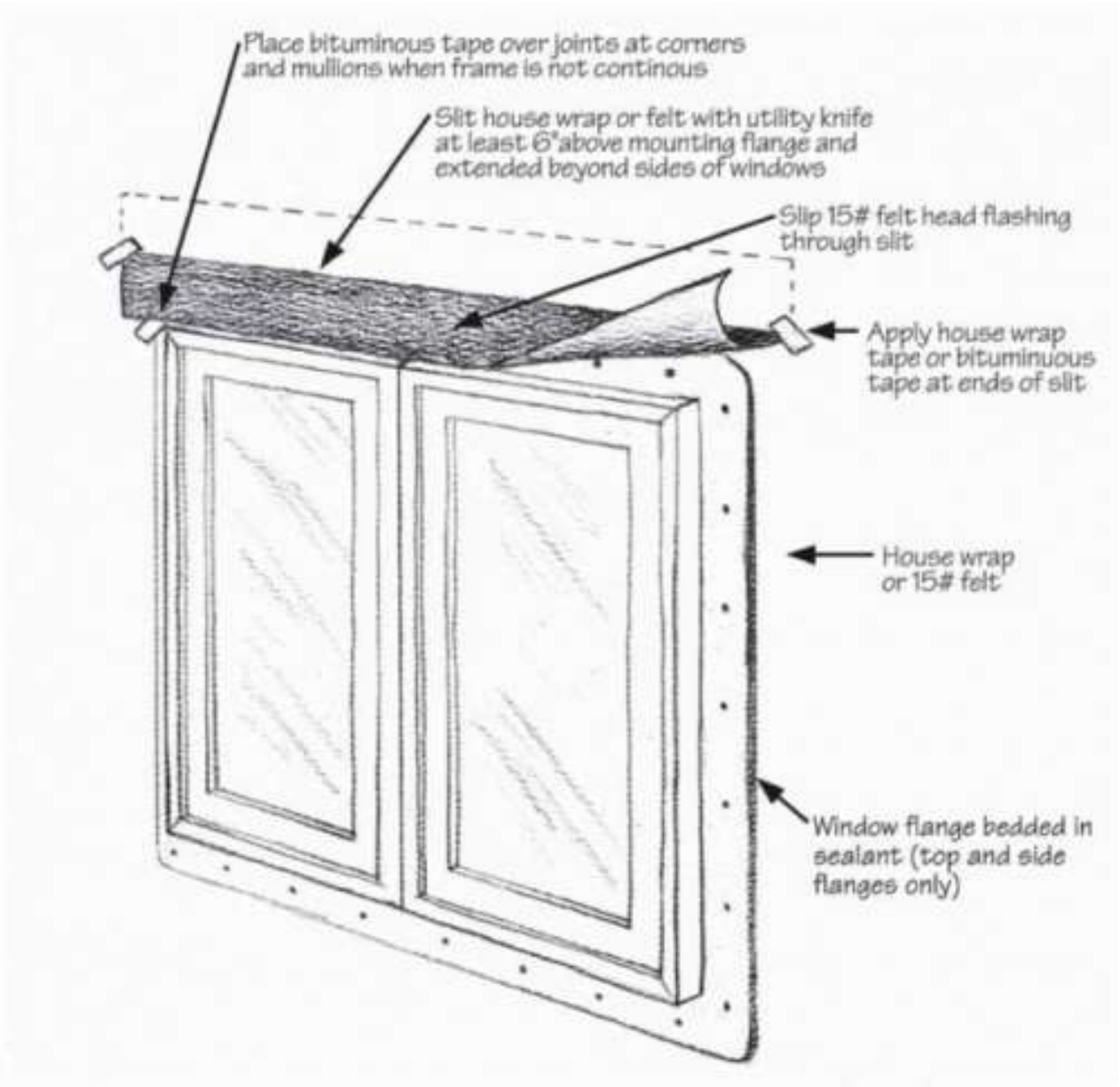
R703.8 Flashing. Approved corrosion-resistive flashing shall be provided in the exterior wall envelope in such a manner as to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at all of the following locations:

1. *exterior window and door openings. Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage;*
2. *at the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings;*
3. *under and at the ends of masonry, wood or metal copings and sills;*
4. *continuously above all projecting wood trim;*
5. *where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction;*
6. *at wall and roof intersections; and*
7. *at built-in gutters.*

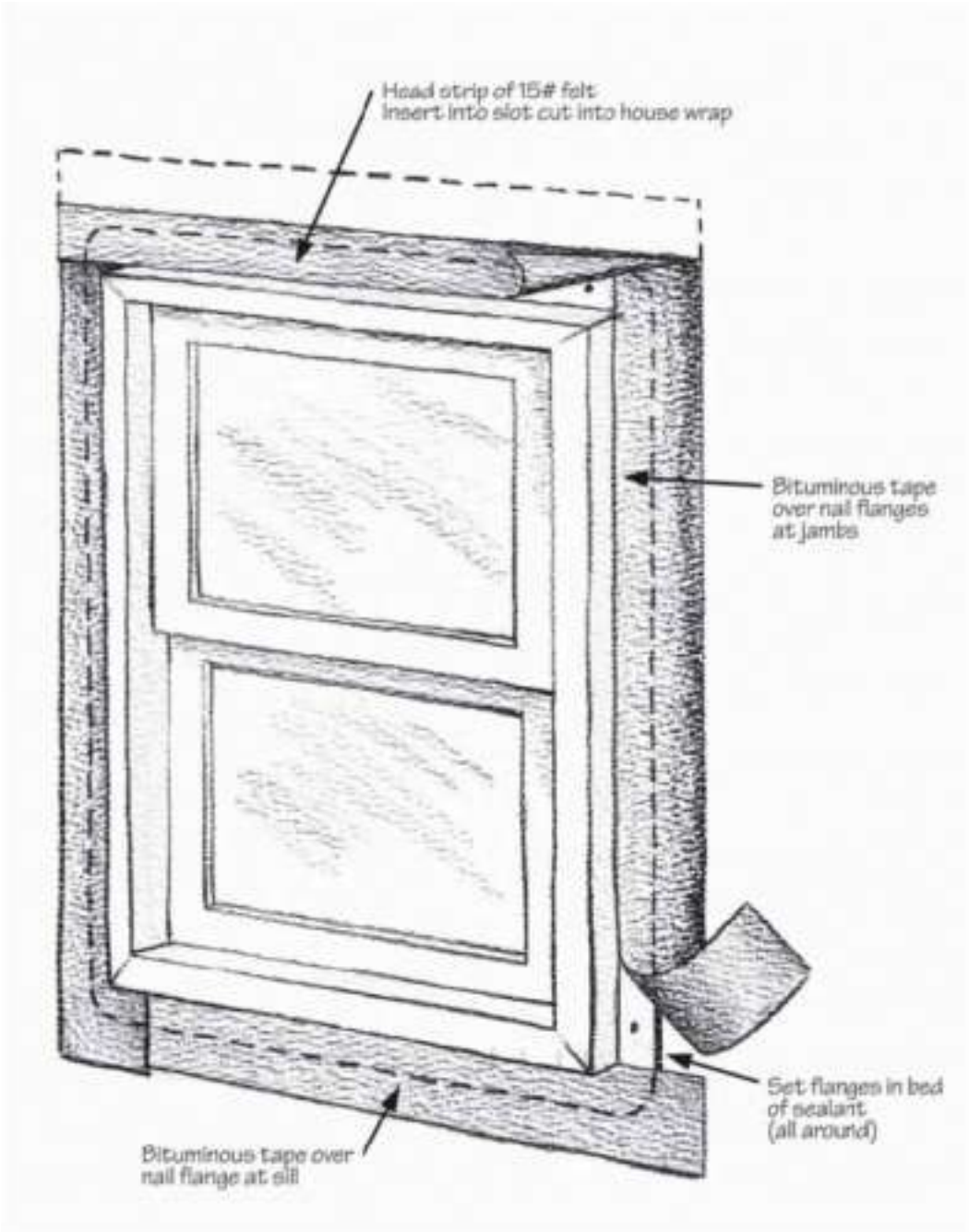
24.1 Understanding and Inspecting Flashing

In the illustrations of this section, there are some typical yet very important flashing

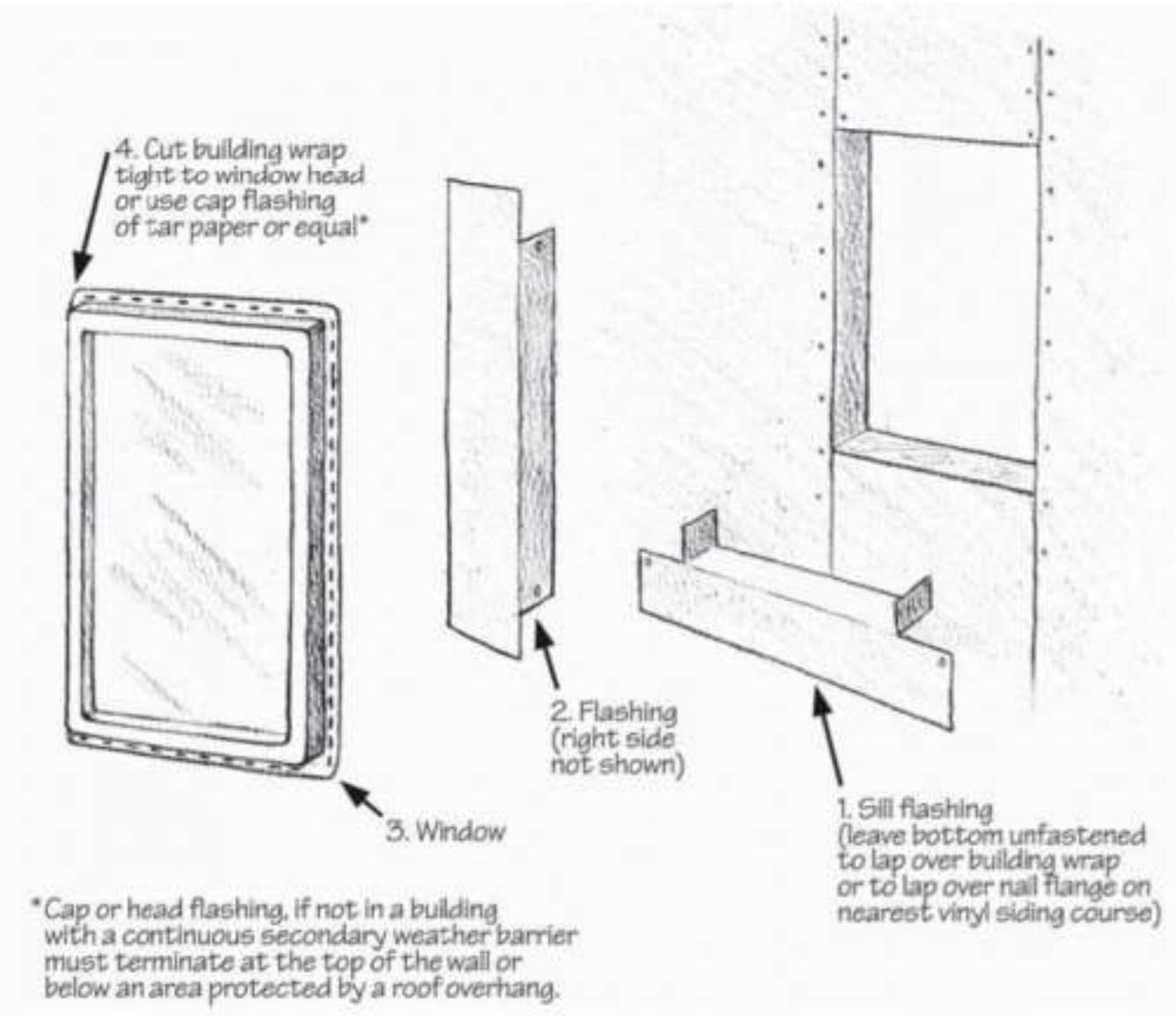
details provided as general guidelines for correct installation techniques. They are not presented as the only solutions to flashing -- because there are certainly many other viable solutions -- but as examples of workable approaches for protecting shell penetrations from water intrusion.



Window flashing and deck-ledger flashing are essential for preventing water damage to wall assemblies. A kick-out flashing is important to protect against water intrusion. A variety of manufactured windowsill and door threshold flashing components (such as pre-molded pan flashings) are also available in lieu of site-built flashing components. These components are used to expel any water leakage at the base of windows and doors.

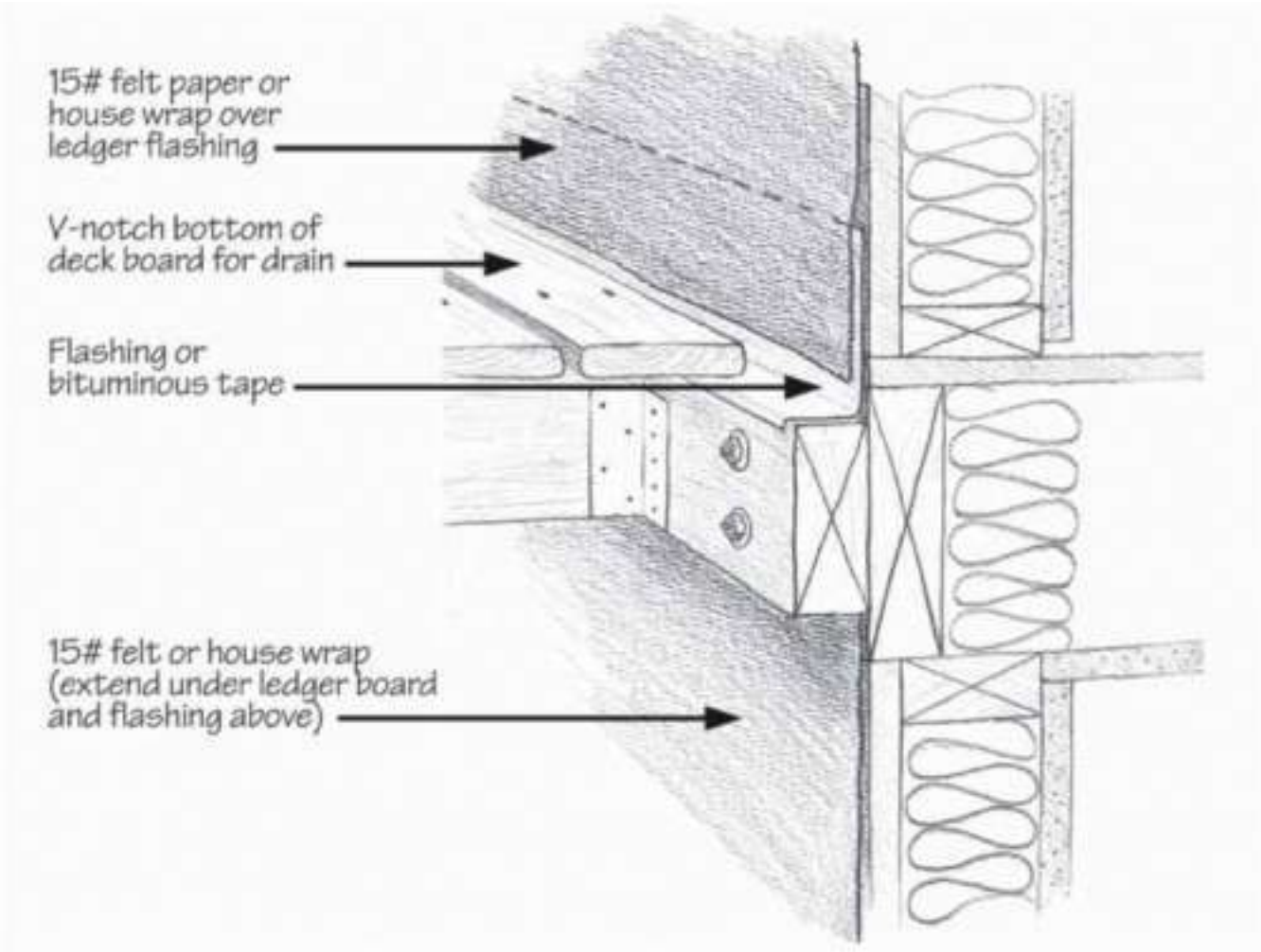


The illustration shows window flashing details that can be used depending on when windows are installed related to the envelope's weather barrier (housewrap or building paper).

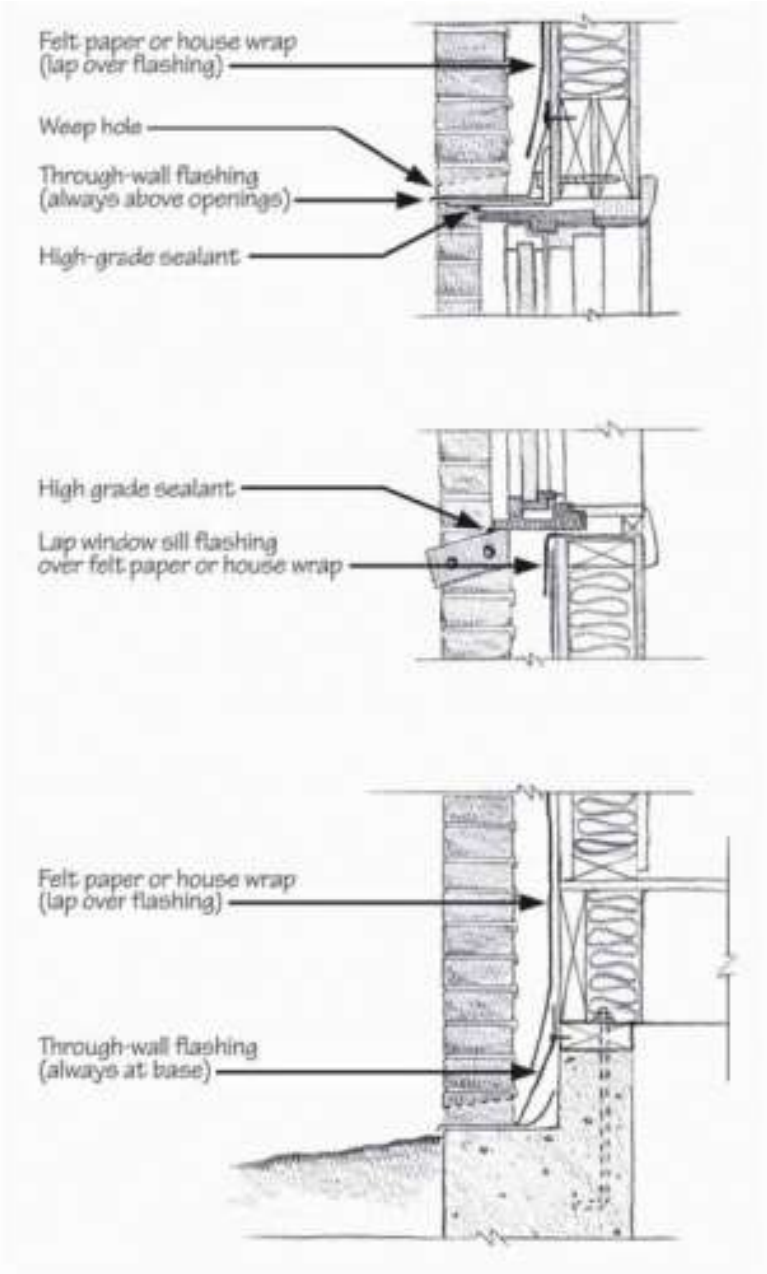


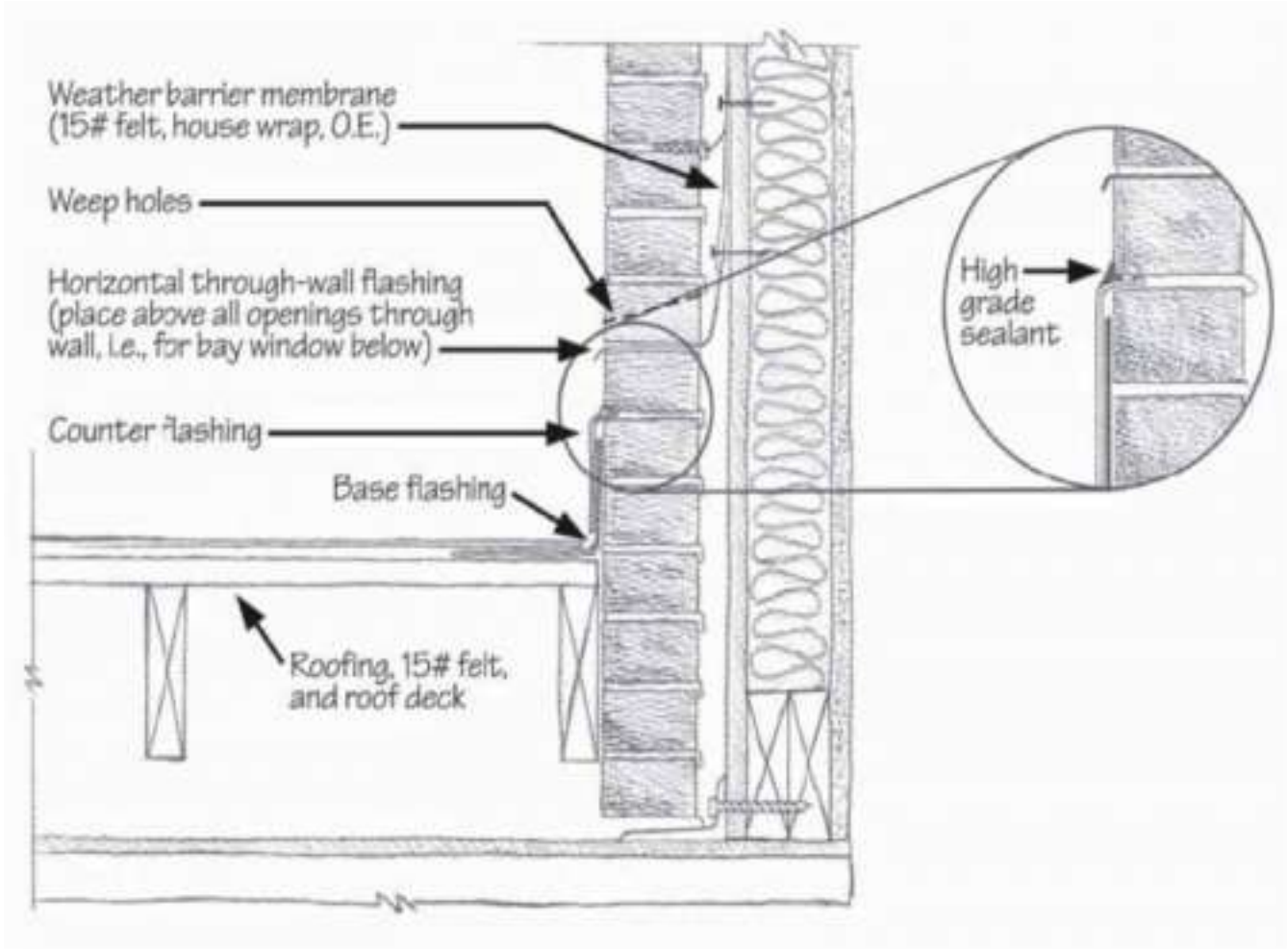
In the next illustration, the flashing details at the jamb and the sill are designed to provide protection against water intrusion in more severe weather conditions.

This is an illustration of a flashing practice at a deck attachment to a house's exterior wall.



This illustration shows flashing details at a brick veneer wall.





24.2 Flashing

Flashing is designed to protect against water intrusion at joints, changes in direction of certain building components, and between different materials. Flashing that is not functioning properly will allow water to penetrate the exterior envelope of the house.

Flashing can be made of galvanized steel, aluminum, alloys of steel and aluminum, copper, lead, and other materials. Flashings could be made of a single component or of two components, such as a step- and a counter-flashing combined. Counter-flashing protects the step-flashing by overlapping it. Siding material may act as a counter-flashing.

Head flashing, sometimes called drip cap flashing, is installed over windows and doors. Head flashings are installed on houses with siding. Head flashings are sometimes not installed when a window is significantly recessed, or when the

window is close to the top of the wall and there's a roof overhang above the window.

24.3 Flashing and Caulking

"Caulk" refers to the caulking substance and to the process of applying it. In the building trade, caulking refers to the activity of closing up joints and gaps in buildings, making the joints watertight. The function of caulking is to provide thermal insulation, to control water penetration, and to provide noise mitigation.

Caulk	Life (in years)	Indoor / Outdoor	Paintable?
acrylic latex	2 to 10	mostly indoors, protected or painted	yes
silicone latex	10 to 15	indoors and outdoors	yes
silicone	20+	indoors and outdoors	no
butyl rubber	7 to 10	outdoors, narrow openings in wood, metal, glass, masonry	no
polysulfide rubber	20+	anywhere	yes
polyurethane	20+	anywhere	yes
weatherstrip / caulking cord	up to 20	indoors and outdoors	no

Water intrusion around windows and doors is a common concern. Water intrusion

around windows and doors may be significant because the problem could be concealed and not discovered for many years.

An exhaustive tutorial on the numerous types of windows and doors, as well as their installation requirements according to each manufacturer, are well beyond the scope of an inspection and this course.

However, you can use common sense and experience to guide you through your understanding and inspection of windows and doors, and their related flashing and caulking installations. Imagine the way water moves down the exterior wall. Imagine how water may be diverted away from critical areas around the windows and doors. Imagine how water is driven against the siding materials, comes in contact with the flashing or caulking, and is diverted away from the exterior wall and its components. Your understanding of how water travels down the exterior wall siding will help you to focus on areas around the windows and doors that may need closer observation or further investigation. Properly installed flashing and caulking should divert water away from the house and not cause or contribute to water intrusion problems.

Uses	**Comments**
patching and filling holes	low flexibility, significant shrinkage
general- purpose	low flexibility
general-purpose, bathroom, kitchen	very flexible, good UV resistance
gutters, storm windows, metal to masonry, metal to metal	low flexibility
outdoors	needs protection from UV
outdoors, driveway seams,	good adhesion to surfaces
sealing and plugging holes	good for energy savings

There are many different caulks available. Some of them last 20 years. Be sure to inspect for caulking that is in poor condition that may lead to water intrusion. Note any recently applied caulking and inspect closely at those areas. New caulking may indicate a repair by the homeowner, or it could be an indication of regular maintenance.

24.4 Sealants for Through-Wall Penetrations

Utility penetrations through foundation walls should be carefully sealed on the exterior face of the wall prior to placement of waterproofing materials and backfill. High-quality urethane caulks are most suitable for this application. In addition, the wall construction should be inspected for penetrations due to voids or other problem areas (such as form ties), and appropriately repaired and sealed.

Inspection Tips

Check for water damage and rot at horizontal surfaces, including windowsill areas and door tread areas. The bottom corners of the side jambs at windows and doors are important areas to inspect. You can use the handle-side of a screwdriver to tap on wood to listen for soft-sounding areas that may be damaged.

24.5 Kickout Flashing

Kickout (or kick-out) flashing, also known as diverter flashing, is a special type of flashing that diverts rainwater away from the cladding and into the gutter. When installed properly, it provides excellent protection against the penetration of water into the building envelope.

Several factors can lead to rainwater intrusion, but a missing kickout flashing, in particular, often results in concentrated areas of water accumulation, and potentially severe damage to exterior walls. Inspectors should make sure that kickouts are present where they are needed and that they are installed correctly.

Water penetration into the cladding can occasionally be observed on the exterior wall in the form of vertical water stains, although inspectors should not rely on visual identification alone. There may be severe damage with little or no visible evidence.

Problems to Look For

Inspectors may observe the following problems associated with kickout flashing:

- The kickout was never installed.
  The need for kickout flashing developed fairly recently and the builder may not have been aware that one was required. The increased amount of insulation and building wrap that is used in modern construction makes buildings less breathable and more likely to sustain water damage. Kickout flashing prevents rainwater from being absorbed into the wall and is more essential than ever.

  Kickout flashing is critical:
  - anywhere a roof and exterior wall intersect, where the wall continues past the lower roof edge and gutter. If a kickout flashing is absent in this location, large amounts of water may miss the gutter, penetrate the siding, and become trapped inside the wall; and
  - where gutters terminate at the side of a chimney.

- The kickout was improperly installed.
  - The bottom seam of the flashing must be watertight. If it is not, water will leak through the seam and may penetrate the cladding.
  - The angle of the diverter should never be less than 110°.

- The kickout was modified by the homeowner.
  - Homeowners who do not understand the importance of kickouts may choose to alter them because they can be unsightly. A common way this is done is to shorten their height to less than the standard 6 inches (although some manufacturers permit 4 inches), which will greatly reduce their effectiveness. Kickout flashings should be the same height as the sidewall flashings.
  - Homeowners may also make kickout flashings less conspicuous by cutting them flush with the wall.

In summary, kickout flashing should be present and properly installed in order to direct rainwater away from the cladding.

Quiz 13

T/F: Damp-proofing does not provide the same degree of moisture protection as does waterproofing.

- True
- False

_____ is the application of one or more coatings of impervious compounds that prevent the passage of water vapor through walls under slight pressure.

- Damp-proofing
- Waterproofing
- Drywalling

T/F: The design of PWFs requires that dry soil be maintained around the foundation.

- True
- False

T/F: Plywood panel joints in foundation walls should be sealed their full length with a caulking compound.

- True
- False

Generally speaking, there should be ____ inches of clearance between the siding and the ground surface.

- 6 to 8
- 8 to 12
- 10 to 18
- 2 to 3

T/F: Where a roof meets an exterior wall, the best building practice is to leave some distance or clearance between the bottom of the exterior wall covering and the roof surface.

- True
- False

T/F: To protect against decay, the ends of wood beams entering masonry walls should have a clearance of at least ½-inch all around.

- True
- False

T/F: Moisture or water vapor can move in and out of a house with air currents.

- True
- False

_____ is designed to protect against water intrusion at joints, changes in direction, and between different materials.

- Flashing
- Siding
- Insulation
- Sealant

Kickout flashing, also known as diverter flashing, is a special type of flashing that diverts rainwater away from the cladding and into the _____.

- gutter
- driveway
- soffit
- downspout

Section 25: Understanding Exterior Drainage Systems

25.0 Understanding Exterior Drainage Systems

This section deals with the details of exterior drainage of the property that may be observed during an inspection of the exterior.

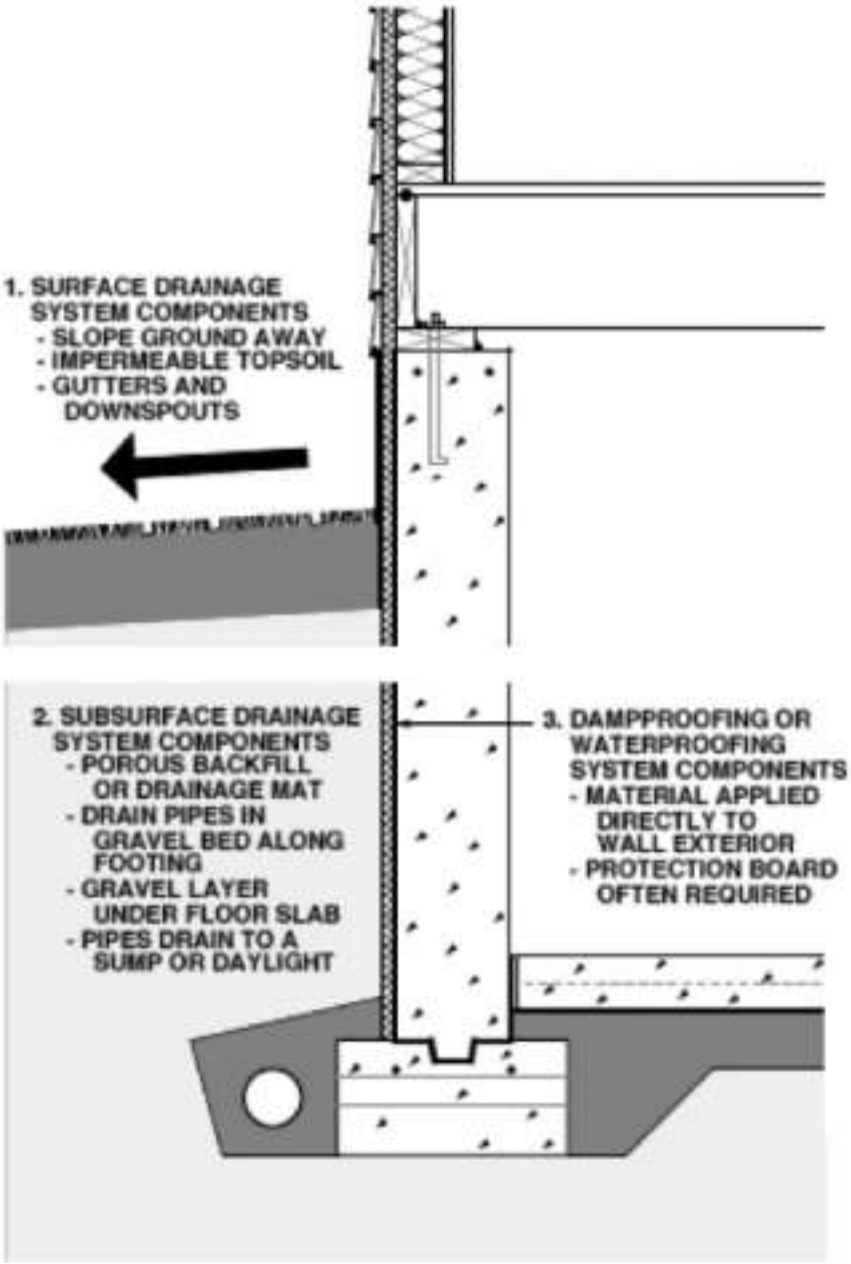
At the end of this section, you should be able to:

- describe how the site surface drainage functions;
- describe how the foundation drainage functions;
- describe how the roof drainage functions; and
- list some common concerns related to an exterior drainage system.

Foundation drainage serves a number of roles. First, it removes “free water” from the foundation perimeter, which reduces the lateral or sideways load on the foundation wall. It also lowers the groundwater level in the vicinity of the building footprint, should it become elevated above the basement-floor level during a

particularly wet season or year. Remember that basements should not be used where groundwater levels are frequently near the basement's floor level.

Current model building codes require that drains be provided around all foundations that enclose habitable space, such as basements. However, exceptions are made for soils that are naturally well-drained. Unless a site-specific soil investigation is done, or extensive local experience confirms that groundwater levels are consistently deep, soil should not be assumed to be well-drained.



Where the foundation drainage system cannot be drained to daylight by gravity, a sump and pump must be used to collect the water and discharge it to a suitable outfall (such as a rock pad and swale) a safe distance away from the building's foundation. Furthermore, use of a drainage layer underneath the entire basement floor slab (coupled with weeps to a drainage system around the outside perimeter of the foundation) may be a more effective way to eradicate conditions where the potential for high groundwater levels near the basement floor elevation may exist. Experience has shown that trying to seal moisture out of a foundation is not nearly as effective as diverting the moisture with a drainage system before it gets inside the living space.

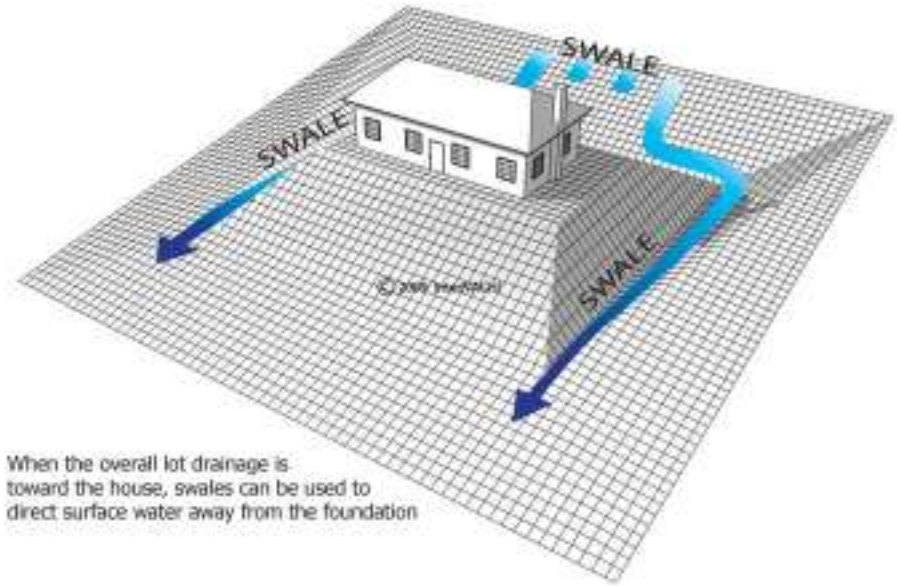
25.1 Site Surface Drainage

Inspecting site drainage is important. Site drainage refers to the control of surface water by the design of the land of a property in relation to the location of the house structure. Proper surface drainage prevents wet basements, damp crawlspaces, eroded banks, and the possible failure of foundations. Water that is not diverted away from the foundation may eventually penetrate its walls or cause moisture problems for the foundation system.

There should be adequate slopes of the land and ground around a property. "Slope" refers to the land around the house that is graded at an angle. The slopes of the ground should be directed toward appropriate and approved drainage devices that are capable of carrying concentrated runoff.

Slopes are divided into classifications, from level to very steep. A property that has a steep slope graded away from the house structure has fewer surface water problems than a slope that is level.

Swales



When the overall lot drainage is toward the house, swales can be used to direct surface water away from the foundation

Surface drainage should be diverted to a storm sewer so as not to create a hazard. Gutters and downspouts are used to direct roof water to the appropriate drainage points.

Drains or swales are effective measures that provide the necessary slope from the house structure. Property lots should be graded so as to drain surface water away from the foundation walls. When the overall lot drainage is toward the house, swales can be used to direct surface water away from the foundation.

The grade should slope a minimum of 6 inches within the first 10 feet. There are exceptions to this rule when drains and swales are provided. Minimum slopes are often based on the ground frost and moisture conditions of the local area. The soil permeability and the drainage type are also important.

Your task should include walking the perimeter of the house and the surrounding land. Verify that the site appears to be adequately sloped away from the house.

Soil

Soil composition is another factor in understanding the performance of the graded site to control surface water. Soil is made up of varying mixtures of sand, silt, loam and clay. The soil composition determines the permeability and percolation rates. Permeability of soil refers to the ability of the soil to absorb water. The percolation rate refers to the speed at which standing water is absorbed into the soil. Clay soil is less permeable than sandy soil. The rate of percolation of sandy soil is greater than that of clay soil.

Soil that is composed of either sand or clay is problematic. Clay soil expands when it gets wet, and it shrinks when it dries. During expansion, the clay soil can actually lift a foundation. During shrinkage, the soil can allow the foundation to drop or sink. Soil that is composed primarily of sand becomes very heavy during a wet period, causing significant hydrostatic pressure against a foundation wall.

25.2 Foundation Drainage

Drains are usually placed around houses to remove groundwater that may be

adjacent to the foundation wall. Such drains prevent leakage into the interior space below grade, such as a basement or crawlspace. Drainage pipes or tiles are important in areas that have moderate to heavy rainfall and soils with a low permeability rate.

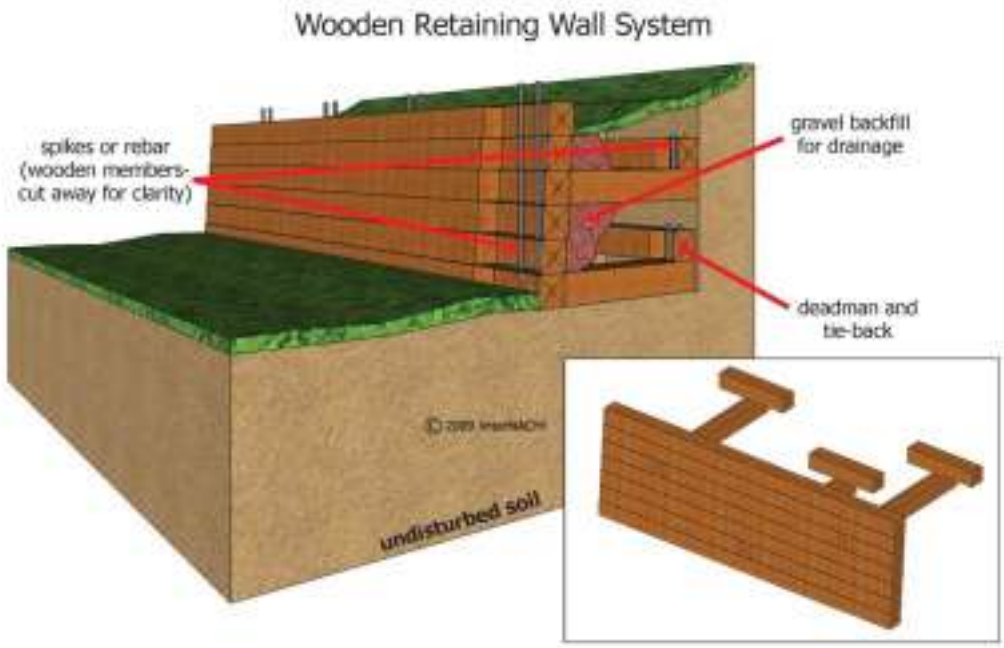
Drains should be installed around all concrete and masonry foundations that are below grade and enclose a habitable or usable space. Drainage tiles, gravel or crushed stone, drains, perforated pipe, or other approved systems or materials should be installed at the areas to be protected. The drainage tiles should discharge by gravity or some mechanical means into an approved drainage point.

Drainage systems are not required if the foundation is in an area with sandy, gravely soils or well-drained ground.

25.3 Roof and Surface Drainage

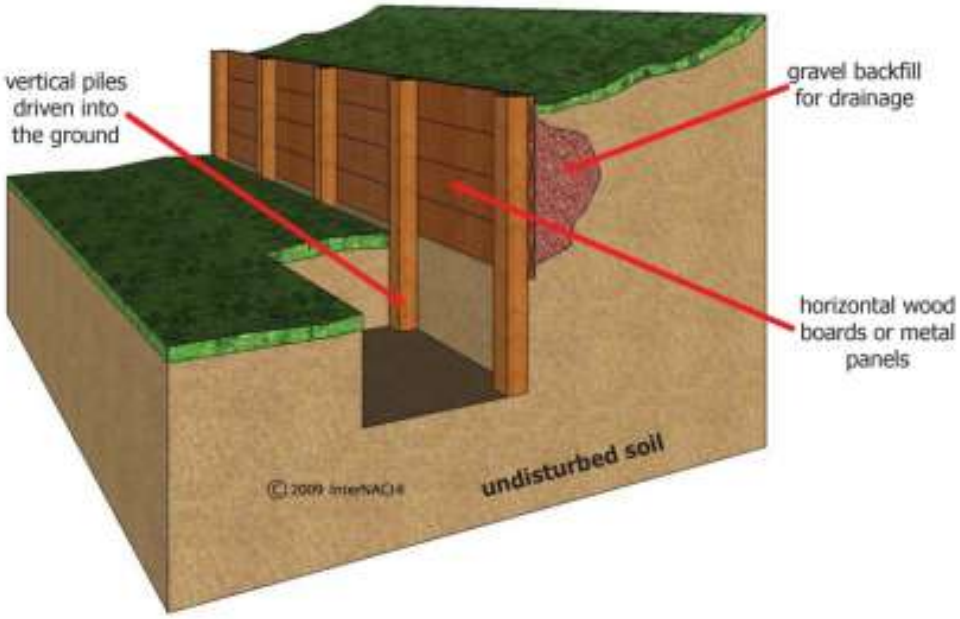
During a typical home inspection of the exterior, the inspector should check the vegetation, surface drainage, and retaining walls when these are likely to adversely affect the structure.

This section covers the roof drainage systems, surface drainage, grading, driveways, walkways and retaining walls.



A home inspector is not a soil engineer. You don't have to identify geological conditions or soil conditions. A home inspector should be able to understand that water and erosion may affect a house.

Pile Retaining Walls (Shoring)



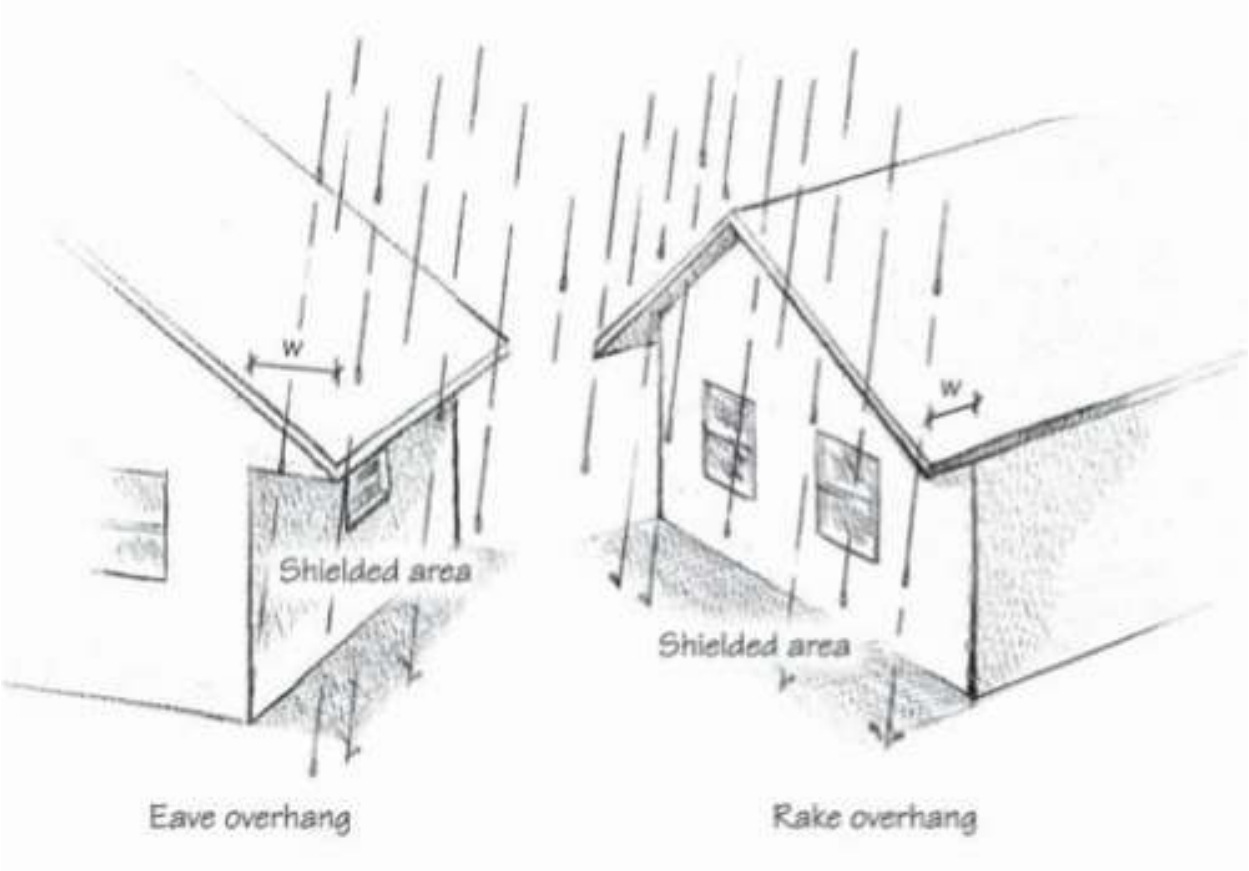
There are many home systems, components, conditions and ancillary structures that are beyond the scope of a home inspection. Many inspectors inspect these systems and components as a courtesy or for an additional fee. They may include pools, tennis courts, hot tubs, playground equipment, ponds, fences, gardens, septic components, etc. It will be up to you to determine how much ground you include in your inspection. What if the property is half an acre in size? That's fairly easy to include in your inspection. What if the property is 20 acres with rolling hills? How far do you visually inspect? How much of the landscaping, property, grounds, grass, yards and fields do you inspect? This is a judgment call. Be sure to communicate your inspection limitations and restrictions to your client prior to your inspection, during your inspection, and within your inspection report.

25.4 Roof Overhangs and Projections

Roof overhangs and projections, such as porch roofs and overhanging floors, provide a primary means to deflect rainwater away from the house's exterior

walls. Thus, the potential for water penetration through siding, windows and doors is minimized. The protection of roof overhangs increases with increasing overhang width.

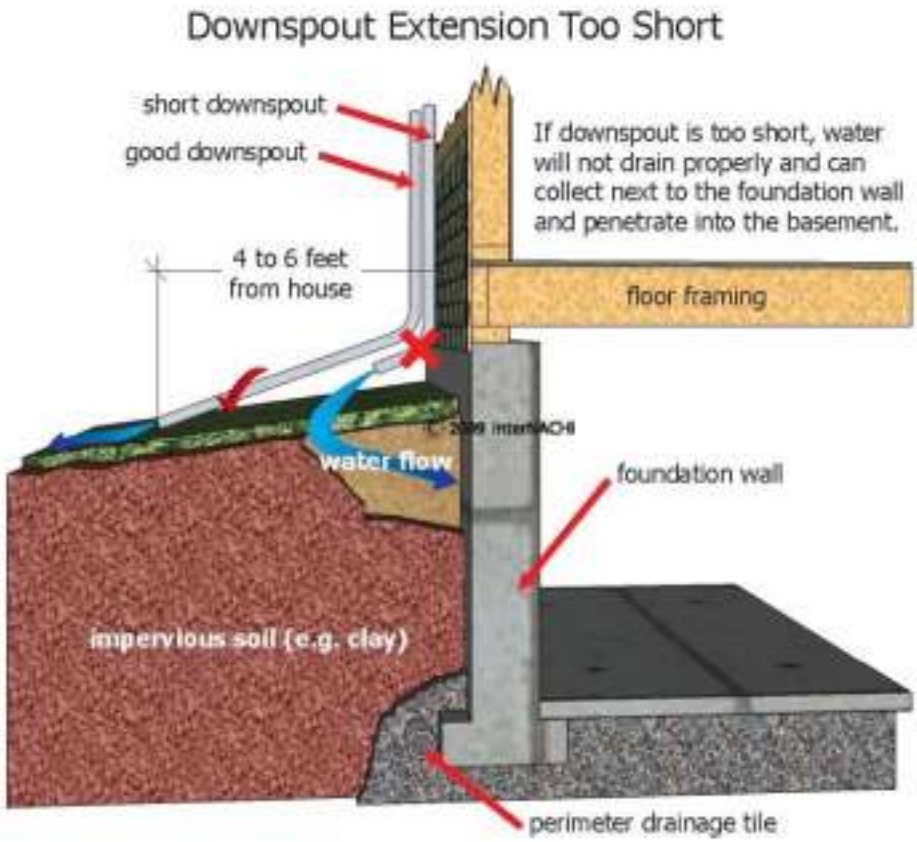
Roof overhangs offer limited benefits during periods of severe wind-driven rain, such as thunderstorm fronts and tropical storms, as well as in arid regions where rain is not a major concern. In severe wind-driven rain climates, a well-performing, weather-resistant barrier for walls is at least as important as providing roof overhangs. In high-wind areas, overhangs add wind-uplift load to the roof and may require stronger roof-wall connections.



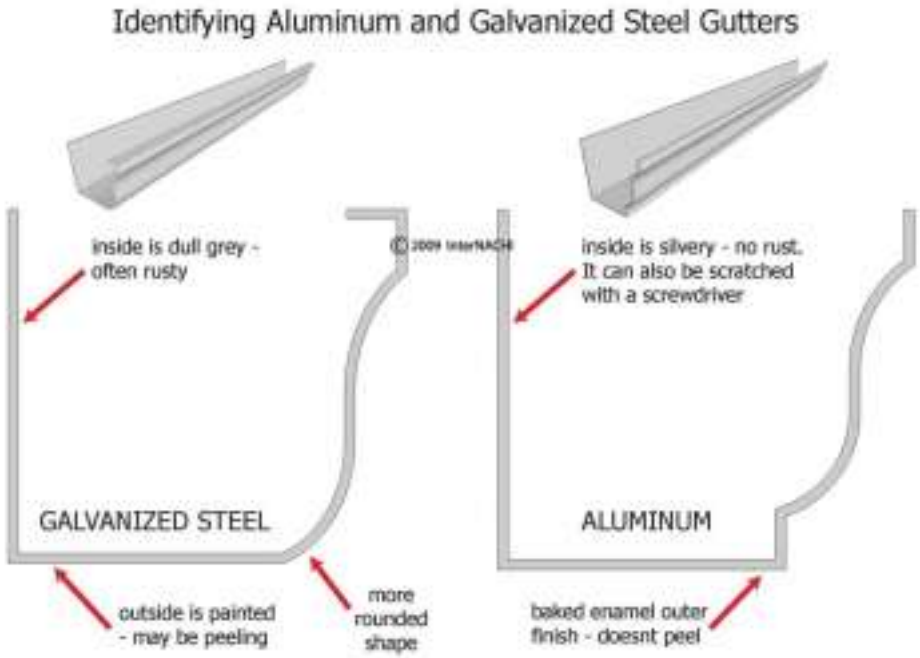
For taller structures, larger roof overhangs are desirable. Alternatively, porch roofs or floor overhangs can be used to protect lower-story walls. Some U.S. building codes do not prescribe a minimum width for roof overhangs.

25.5 Roof Drainage, Gutters and Downspouts

While roof overhangs and porch roofs protect building walls from impinging rain, gutters serve to protect building walls and foundations from roof water runoff. Roof gutters, downspouts and leaders or diverters form the initial components of a drainage system for the building and site. During an inspection, check for proper design of gutters and downspouts for water-shedding and steep-slope roof systems.



Drainage of low-slope roofs is accomplished in one of three ways: without gutters or downspouts; with gutters and downspouts; or by downspouts that go down through a building's interior. Drainage without gutters or downspouts can damage the exterior wall with overflow. If the roof has no gutters or downspouts, carefully check the exterior walls for signs of water damage.



Most functional gutters have a minimum ratio of gutter depth-to-width of 3:4. The front edge is typically ½-inch lower than the back edge. The minimum width is generally 4 inches, except on the roofs of canopies and small porches. If there is a screen or similar device to prevent anything but water from flowing into the gutter, its performance during a rainstorm should be checked to be sure water can actually enter the gutter. Check gutters without screens or similar devices to be sure that basket strainers are installed at each downspout.

All gutters need to be kept clean and clear of debris. They should slope uniformly, without sags, to downspouts. Gutter and downspout components are typically made of galvanized steel, aluminum, copper and plastic.

Buildings with pitched roofs may have a variety of drainage systems. With a sufficient overhang, water can drain directly to the ground without being collected at the roof edge.

Common problems with guttering are related to installation and maintenance. Home inspectors are not required to check if properly sized components have been installed. Sizing is beyond the scope of a home inspection. Home inspectors can check to see whether the guttering is appropriately sloped toward adequately sized downspouts, and whether the discharge is directed away from the building perimeter.

Properly Sized Roof Drainage System

Checking whether the roof drainage system is properly sized is beyond the scope of a typical home inspection. There are two steps to checking a steep-slope roof drainage system that uses standard guttering products. They include referring to the rainfall intensity and the roof drainage system's spacing and layout.

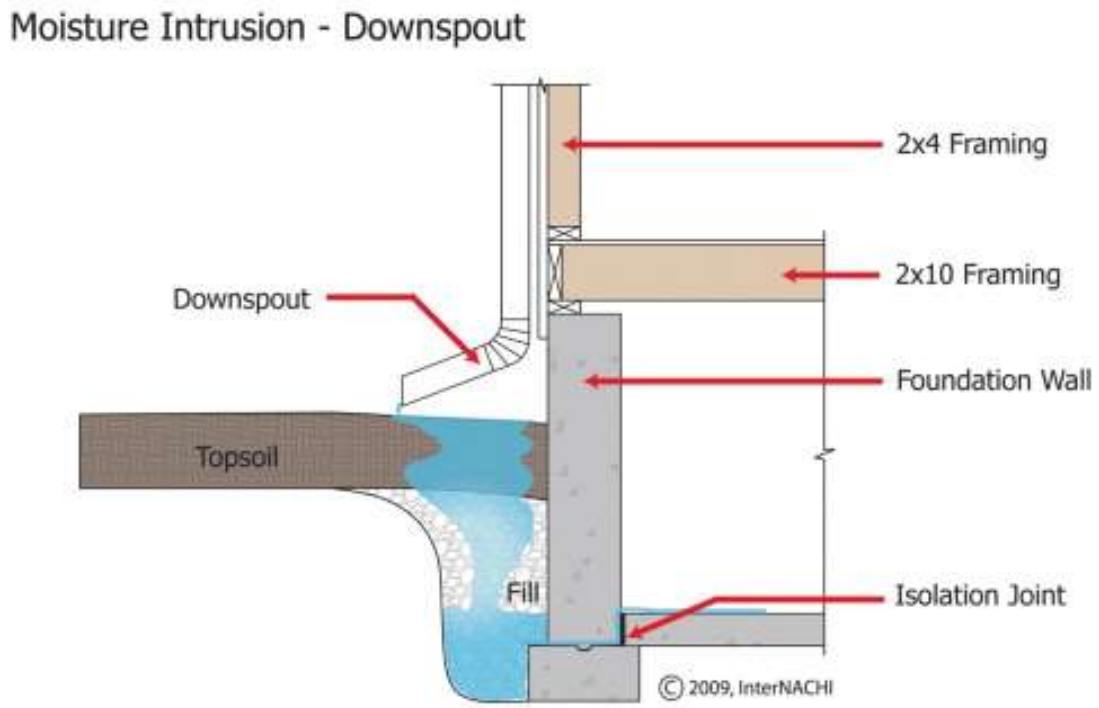
Puddles Are Not Good

The ground surface beneath decks, porches and other parts of a building that are supported by posts or cantilevered structures should be checked. It should not have any low-lying areas but should be sloped so that water will not collect and puddle

there. Settled backfill allows water to collect next to the foundation wall and penetrate into the basement.

Downspouts Need Adjustment

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 onto or over a walkway, driveway or stairs. The downspouts on a building on a hillside should discharge on the downhill-side of the building. The force of the water leaving a downspout is sometimes great enough to damage the adjacent ground, so some protection at grade is needed, such as a splash block or a paved drainage chute. In urban areas, it is better to drain downspouts to an underground storm-water drainage system, if there is one, or at a lower grade away from buildings.



Water that flows directly off a roof that lacks 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.

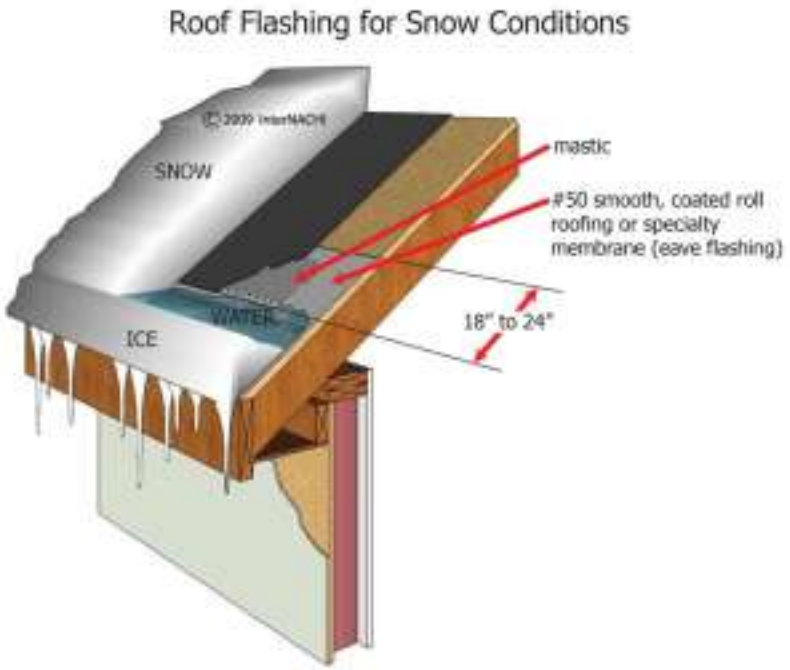
Gutters

Joints at the gutters should be soldered or sealed with mastic. Otherwise, they'll leak. The steeper the roof pitch, the lower the gutter should be placed. On roofs

with lower slopes, gutters should be placed close to the roof's surface. Hangers should be placed no more than 3 feet apart. Where ice and snow are long-lasting, hangers should be placed no more than 18 inches apart. The strength of a gutter's fastening to the roof fascia or building exterior should be strong and secure. Rusted fasteners and missing hangers should be replaced.

Ice Dams

Ice dams can form on pitched-roof overhangs in cold climates subject to prolonged periods of freezing weather, especially those climates with a daily average January temperature of 30º F (-1º C) or colder. Heat loss through the roof and heat from the sun (even in freezing temperatures) can cause snow on a roof to melt. As water runs down the roof onto the overhang, it can freeze and form an ice dam just above the gutter. The ice dam traps water from melting snow and forces it back under the roof-covering material and into the building's interior.



Watch the edge of the roof overhang for evidence of ice dams, and look at the eaves and soffit for evidence of deterioration and water damage. If the house has an attic, the underside of the roof deck at the exterior walls can be checked for signs of water intrusion

Downspouts

The rule of thumb for downspouts is at least one downspout for every 40 feet of gutter. For roofs with gutters, make sure that the downspouts discharge so that the water will drain away from the foundation. Downspouts can be checked for size. The minimum is generally 7 square inches, except for small roofs and canopies. There should be attachments or straps at the top, at the bottom, and at each intermediate joint.

Downspout fasteners can rust, deform, become loose or fail. On buildings with multiple roofs, one roof sometimes drains onto another roof. Where that happens, water should not be discharged directly onto the roofing material. The best practice is to direct the water from higher gutters so that it discharges into lower gutters through downspout pipes.

Occasionally, wooden gutters and downspouts are used, usually in older and historic residences. They may be built into roof eaves and concealed by roof fasciae. Wooden gutters are especially susceptible to rot and deterioration and should be monitored.

Pitched roofs in older buildings may end at a parapet wall with a built-in gutter integrated with the roof flashing. At this location, drainage is accomplished by a scupper, which is a metal-lined opening through the parapet wall that discharges into a leader head box that, in turn, discharges to a downspout. The leader head box should have a strainer. Check the scupper for deterioration and open seams. All metal roof flashings, scuppers, leader head boxes and downspouts should be made of similar metals to prevent galvanic corrosion.

Inspection Standards

The inspector shall inspect the roof covering from the ground or eaves, vents, flashing, skylights, chimney, and other roof penetrations. The inspector is not

required to walk on the roof, perform a water test, or warrant the roof. Skylights are notorious for leaking water. Prediction of when, how or where a leak will develop is beyond the scope of a visual home inspection.

25.6 Checking the Site & Foundation

A building site, which is comprised of the grounds surrounding the structure, is a vital factor in providing for a moisture-resistant home. Understanding the moisture and drainage conditions at a home is perhaps the first and most important step in inspecting for a moisture-resistant foundation. Building foundations should be located on sites in a manner that prevents moisture problems by providing for adequate drainage of on- and off-site surface water flows, including roof water runoff. Groundwater conditions should also be considered during an inspection of a home with moisture-related problems. The foundation type, foundation elevations, and the foundation's moisture-resistant detailing are related factors that are dependent on a number of site characteristics.

Many sites are considered “normal” and fall within standard conditions addressed in the residential building code. However, the use of marginal sites without the proper site design (which is becoming more common) can result in costly mistakes, such as foundation structural and moisture problems. Appropriate foundation elevations and drainage patterns for the site should be considered.

Check the Site’s Drainage

When a house is built, a site plan should be developed to do more than just locate the building and utilities on the site, and demonstrate compliance with setbacks and

other zoning requirements. The site plan should also consider a drainage plan that indicates the slope of the surrounding land and drainage patterns that convey surface waters away from the building site. For sites that generally provide natural drainage away from the building location, the main concern is establishing an appropriate foundation elevation to maintain drainage immediately adjacent to the foundation.

Model building standards typically require a minimum of 6 inches of fall in ground level over a distance of 10 feet from the perimeter of the building. Providing for additional slope is a good method to offset future settlement of foundation backfill next to the building, unless the soil is moderately compacted or tamped during the backfill process.

Conditions that warrant careful consideration by an inspector at any site include:

- the local high water table that is within 4 to 8 feet of the lowest proposed foundation floor or grade level;
- natural depressions that collect or channel on- and off-site flows;
- natural springs or wet areas on site;
- soft or loose soils indicative of poor bearing capacity;
- building development that will result in more than 10% to 20% impervious-area coverage on the site;
- steep slopes that may be unstable or easily eroded (greater than a 25% slope);
- signs of existing erosion, such as gullies, slope failures, etc.;
- sensitive areas that may be affected by proposed development, such as natural streams, wetlands or other features;
- off-site surface water flows directed onto and across the proposed site;
- inadequate building offset from adjacent steep slopes that generate increased surface water runoff. A minimum offset of 15 feet from the toe of a 1:3 or 33% or greater slope is generally recommended, but special conditions may warrant a greater or lesser amount of offset; and/or
- a 100-year floodplain located on site or near the building location.

Poor site drainage of surface water is perhaps the most important contributor to foundation moisture problems. Thus, the factors listed above should be considered during an inspection.

Wetness of the site, soil-bearing conditions, and slope of the site are key factors in making a decision as to whether to build, and how to build a house. When poor site conditions exist, they can often be overcome technically, provided there are no land-use restrictions involved. However, the added cost of design and non-conventional foundation construction (such as an elevated foundation and/or special drainage features) should be considered a significant part of the expense of building a house. It is usually very costly to correct site drainage problems and foundation moisture

issues after the fact. Therefore, the inspector must be very careful regarding the recommendations s/he makes about a site with poor drainage.

25.7 Inspection of Drainage Slopes

Proper grading to provide positive flow of surface water and roof water runoff and gutter discharge is one of the simplest and most important features on a building site. When possible, the minimum 6-inch fall in finish grade over a distance of 10 feet from the building (minimum 5% slope) should be exceeded and extended. This is particularly important if backfill practices are not reasonably controlled to prevent settlement. On very flat sites, this may require mounding of the foundation pad and coordination of appropriate foundation elevations to promote drainage. On sloped sites, excavation and grading in the up-slope direction must provide for sufficient drainage away from the building perimeter and against the direction of natural water flow on the site. For sites with very steep slopes, this may require use of a retaining wall at the toe of a steep slope.

Backfill and Site-Grading Problems Make for Wet Basements

In one survey of basement leakage problems, about 85% of the moisture problems appeared only after rainstorms or melting snow, which is a strong indication of the importance of site drainage in preventing foundation moisture problems. Of these incidences of basement leakage problems, about 40% were associated with improper surface grading, 25% were related to improper downspout drainage, and another 25% were associated with settling of backfill that resulted in improper surface grading after the passage of time, typically, within the first year after construction. Thus, a majority of basement water problems are associated with backfill and site grading.

Backfill

Backfill soil should be placed in a manner that prevents settlement and potential surface water flow toward the foundation. This may require that backfill soil be placed in 6-inch to 8-inch layers or lifts, and modestly compacted with light construction equipment or tamped to prevent settlement over time. Heavy compaction efforts, which are typical of commercial building and roadway

construction, should not be promoted, as this may damage residential foundation walls. The goal is to compact the soil sufficiently to prevent future settlement from the process of natural consolidation of loosely placed soil. In addition, backfill should not be placed without first installing the floor system or temporary bracing to support the foundation walls.

Finally, the upper layers of the backfill should be of moderately low-permeability soil with some clay content to help reduce the direct infiltration of rainwater adjacent to the foundation. Where only pervious soils are available for backfill, the slope of the grade away from the perimeter of the foundation should be increased, or an impervious skirt of 6-mil polyethylene may be placed about 12 inches below grade.

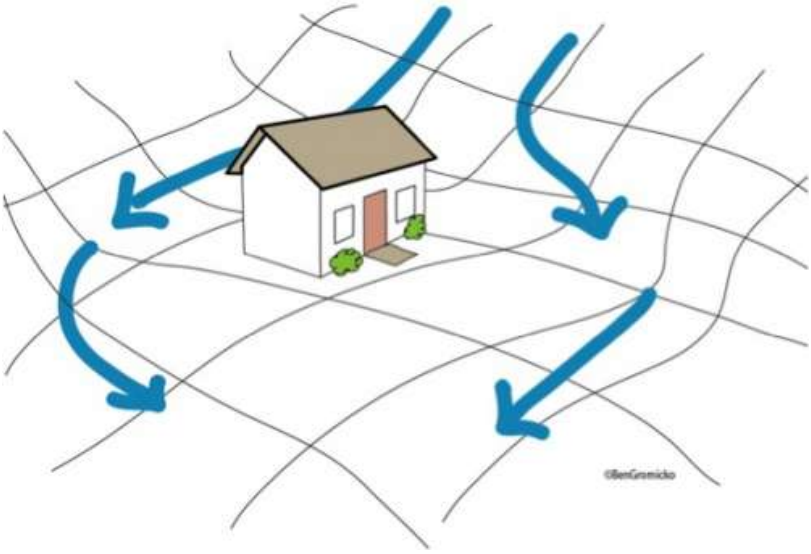
Good Backfill

It is notoriously difficult to control grading and backfilling operations in typical residential construction. On many sites, the common practice is to place the backfill with the least amount of effort required to "fill the hole." Proper backfill practices and grading will ensure that a foundation remains dry to a greater degree than all the other recommendations provided in this section.

25.8 Property Drainage

Convey the following advice to your client:

During a heavy rainstorm without lightning, grab an umbrella and go outside. Walk around your house and look around at the roof and property. A rainstorm is the perfect time to look at how the roof, downspouts and grading perform. Observe the drainage patterns of your entire property, as well as the property of your neighbor. The ground around your house should slope away from all sides. Downspouts, surface gutters and drains should be directing water away from the foundation.



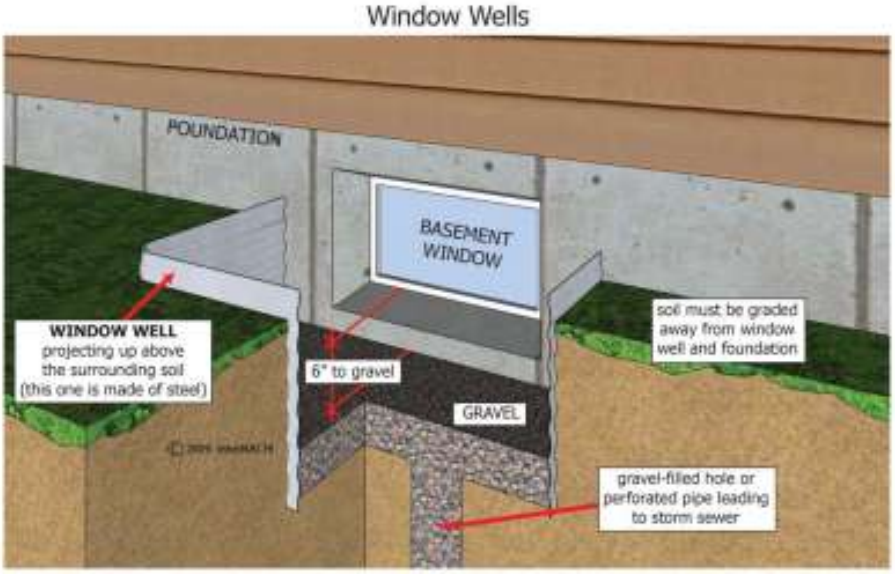
Check the Following

Poor Drainage

Most problems with moisture in basements and crawlspaces are caused by poor site drainage. The ground should slope away from window wells, outside basement stairs, and other means of egress.

The bottom of each of these areas should be sloped to a drain.

Each drain should have piping that connects it to a stormwater 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 discharges the water away from the building.



The property owner must monitor and maintain the drains and piping. Drains and piping should be open and clear of leaves, earth and debris. A garden hose can be used to check water flow, although its discharge cannot accurately approximate storm conditions.

Hillside

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 could be interrupted by a surface-drainage system that collects and disposes of rainwater runoff. Swales, often referred to as ditches, can be used to direct surface water away from the foundation. There are two general types of surface-drainage systems: an open system, consisting of a swale, sometimes with a culvert at its end to collect and channel water away; and a closed system, consisting of gutters with catch basins.

25.9 Sump Pumps

Sump pumps are self-activating electric pumps that protect homes from moisture intrusion. They are usually installed below basement or crawlspace floors to remove rising groundwater and surface runoff before it has a chance to seep into the home. Accumulated water can cause interior damage and encourage the growth of mold, mildew and fungus. Pumps should be maintained and equipped with all necessary components in order to ensure their reliability.

Discharge Location

Inspectors are not required to check for a proper discharge location. They can note an improper discharge if they see it, but searching outdoors for the discharge is not recommended.

The following is general information that can be passed on to the homeowner:

- Water must be discharged at least 20 feet from the building.
- Water should not drain back into the house. Recycling water places unnecessary strain on the pump and can weaken the structure's foundation.
- Water should not drain onto a neighbor's property without their approval.
- Many jurisdictions do not permit residential runoff to be pumped into public sewer systems.
- Pumped water should never drain into a residence's septic system. Especially during heavy rain, a septic drainfield can become saturated and will struggle

to handle the normal flow of water from the house. Additional water from the sump pump can damage the septic system.

Sump pumps are used to remove excess water that would otherwise cause property damage. There are multiple types and they all monitor water levels so that they do not rise higher than predetermined levels. Proper maintenance and inspection will ensure the pump's efficiency and prolong its service life.

Sump Pumps Should Not Recycle

When a sump pump is used to keep a building's interior dry, the discharge should drain away from the building and should not add to the sub-surface water condition that the sump pump is meant to control.

Naturally Wet

Look around the entire site for the presence of springs, standing water, saturated or boggy ground, a high water table, and dry creeks or other seasonal drainage paths, all of which may affect surface drainage.

25.10 Landscaping

Well-maintained landscaping and other improvements are important for the enjoyment of a healthy and durable property.

Plants, Trees and Shrubs

Check the location and condition of all trees and shrubbery. Those that are overgrown should be pruned or trimmed. Where trees or bushes have overgrown, complete removal may be necessary.

Trees Need to Be Trimmed

Overhanging branches should not interfere with a chimney’s draft, damage utility wires, or deposit leaves and twigs on the roof or inside gutters and drains. Trees and

shrubbery that are very close to exterior walls or roofs can cause damage. They can make it difficult to perform homeowner maintenance, repairs and inspections. Branches around the perimeter of the house should be pruned back. Tree roots under concrete walks can cause damage. Roots are usually exposed near the surface and can be cut back. Tree roots can cause foundations to crack by pushing against them from the outside. Homeowners should consider hiring an arborist, who is a specialist in the cultivation and care of trees and shrubs, including tree surgery, and the diagnosis, treatment and prevention of tree diseases, as well as the control of pests. Find a certified arborist in the U.S. at the National Arborists website.

Your task as an inspector is to look for tree branches that are near the house structure. Look for branches that overhang the roof. Leaves and twigs from overhanging branches may clog the gutters. The branches are also attractive to insects, particularly wood-destroying carpenter ants. Tree branches can also cause property damage in a windstorm. Pay attention to branches that are in contact with or near overhead electrical, cable and phone lines.

Proper maintenance of the trees, landscaping and shrubbery can help prevent site and roof drainage problems.

25.11 Fences

Fences are usually installed to provide physical and visual privacy. Fences should be plumb. Some problems with fences are that they can lean over and fall apart. Check wooden fences for the development of rot and insect infestation. Check metal fences for rust. All gates and their hardware should have proper fittings, operation and clearances. Fences are often addressed in homeowner association bylaws and deed covenants. Homeowners should pay special attention to the fence's location in relation to their property lines. Neighbors can get quite un-neighborly about property lines that are violated.

Quiz 14

Foundation _____ removes “free water” from the foundation's perimeter, which reduces the lateral load on the foundation walls.

- drainage
- damp-proofing
- sealant
- reinforcement

T/F: Current model building codes require that drains be provided around all foundations that enclose habitable space, such as basements.

- True
- False

_____ drainage refers to the control of the surface water with the design of the land of a property in relation to the location of the house structure.

- Site
- Foundation
- Groundwater
- Perimeter

T/F: Clay soil expands when it gets wet and it shrinks when it dries.

- True
- False

T/F: Roof overhangs and projections, such as porch roofs and overhanging floors, provide a primary means of deflecting rainwater away from the house's exterior walls.

- True
- False

T/F: Common problems with guttering are typically related to its installation and maintenance.

- True
- False

The rule of thumb for downspouts is at least one downspout for each _____ feet of gutter.

- 40
- 10
- 100
- 24

T/F: Backfill soil should be placed in a manner that prevents settlement and potential surface water flow toward the foundation.

- True
- False

Section 26: Windows and Doors

26.0 Windows and Doors

This section deals with the details of the windows and doors of a house that may be observed during an inspection of the exterior.

At the end of this section, you should be able to:

- describe how windows and doors function;
- list some common concerns with windows and doors; and
- describe fogged windows.

A window is a transparent opening in a wall that allows the passage of light, air and sound. Modern windows can be glazed or covered in some other transparent or translucent material.

A door is an opening in a wall that allows egress. A door provides access in and out of a house.

A properly installed window or door, when closed tightly, should be watertight. Windows and doors can be made of many different types of materials, including wood, steel, vinyl and aluminum. You should inspect the windows and doors from both sides.

During the inspection of the exterior, an inspector can check the windows that are readily accessible. The windows on the second or third floors are not readily accessible, and your client should understand the restrictions of your inspection. Lower-floor windows are often restricted from inspection by bushes and dense vegetation. Windows that are not readily accessible for maintenance may likely be the windows in the poorest condition. The windows that are not readily accessible will likely be the windows that you will not be able to carefully and thoroughly inspect.

26.1 Common Problems

When inspecting the windows and doors, pay attention to their condition, operation, and locking mechanisms, along with any physical damage or water damage.

Common problems with both windows and doors include:

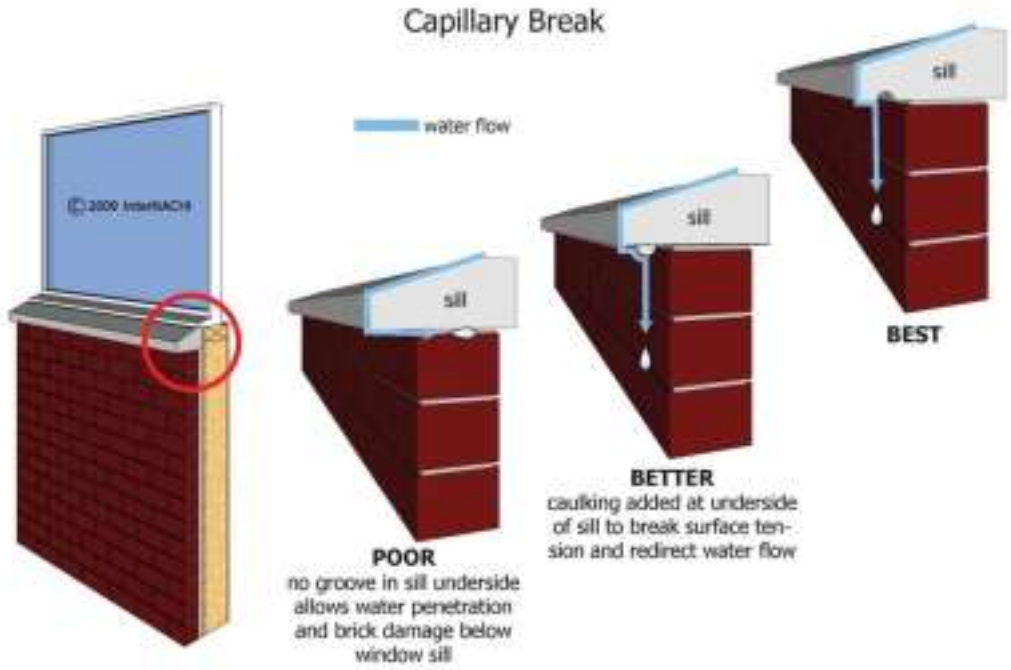
- mechanical damage;
- paint problems;
- flashing defects;

- deteriorated caulk;
- damaged screens;
- cracked glass;
- fogged windowpanes or lost seals;
- putty or glazing problems;
- wood rot; and
- water damage.

Water intrusion problems at the windows and doors are difficult to assess from the exterior. You will get a complete understanding of the windows and doors after inspecting them from both the interior and exterior.

26.2 Windowsills and Door Sills

A sill at a window or door should be sloped. Windows and doors have nearly horizontal surfaces that can collect water. Functional sills are sloped to divert water away from the window or door. Windowsills have a projection designed to divert water away from the exterior wall.



One detail to check for at a windowsill is something that creates a capillary break. Under the projection of the windowsill, there should be a detail such as a groove or cut. This detail should run along the length of the windowsill and parallel to the wall. This capillary break stops water from running under the projection and back to the wall, and forces the water to drip.

Windowsills deteriorate because of exposure to weather, UV radiation from the sun, and normal wear. Wooden windowsills are prone to wood rot. Masonry windowsills may crack. Vinyl windowsills may crack or become functionally damaged. Metal windowsills may rust or corrode. The chance of deterioration is greater when the windowsill is not sloped properly, lacks a drip edge, or experiences delayed maintenance.

Inspection Tips for Windowsills

Be careful when using a probing instrument. Consider using your fingers or thumb to press on suspected damaged areas at the windowsills. Check the bottom corners and edges for water damage and rot. Note any repairs that appear to be recent or poorly made. Window air conditioners often have deteriorated, damaged windowsills. The condensate water that is produced by window air conditioners is often the cause of major water intrusion and wood damage.

Be sure to note cracked and damaged glass, missing and damaged window screens, fogged windowpanes, and lost seals. You should report as in need of repair any windows that are obviously fogged or display other evidence of broken seals. Cracked glass is a safety hazard. Missing and damaged screens are not typically considered to be major problems, and are usually not within the scope of a home inspection. Many inspectors will make notes about the window screens as a courtesy for their clients.

26.3 Windowsill Height

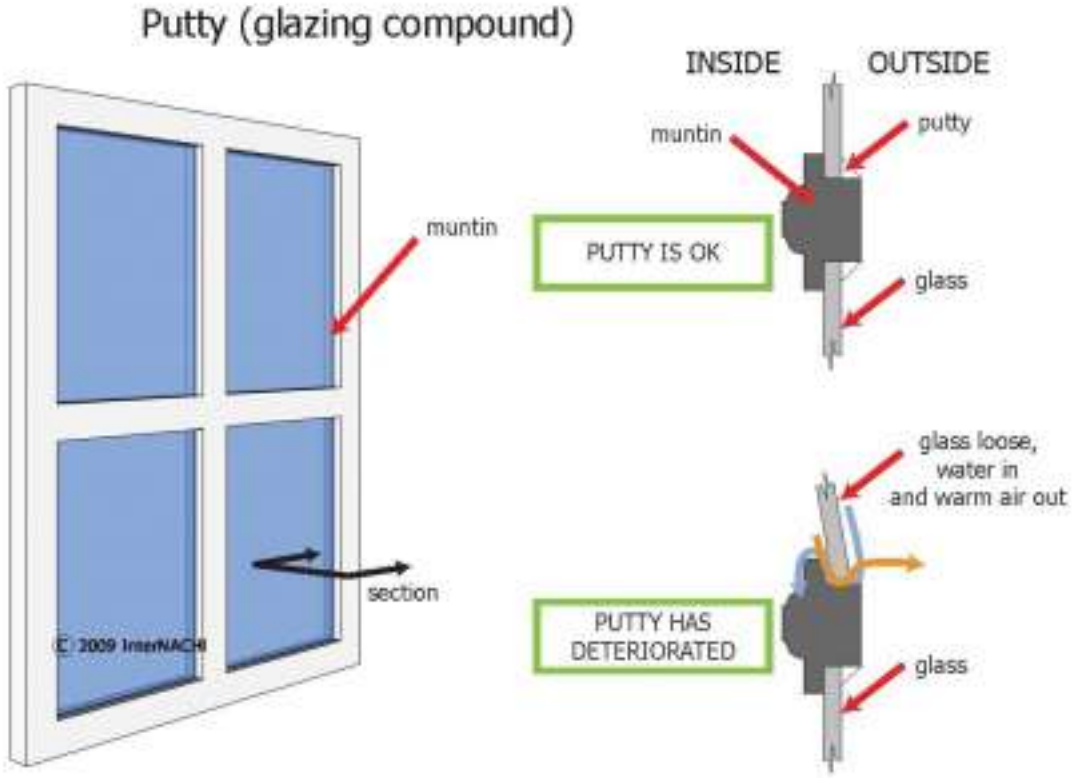
Every year, children fall from windows. A large percentage of those falls occur through windows with a low sill height. The restrictions of sill height are intended to raise the height of the opening at the sill above the center of gravity of a small child, thus reducing the number of falls.

Where the opening of an operable window is located more than 72 inches above the ground outside, the lowest part of the clear opening of the window shall be a minimum of 24 inches above the finished floor of the room in which the window is located. From the outside, it is not possible to see the height measurements of the window from inside the room, but this is a safety issue that you could keep in mind while inspecting both sides of a particular window.

The exterior inspection of a window is directly related to the interior inspection of the same window. Both sides should be inspected.

26.4 Putty

Glazing putty is made by mixing a base of finely ground chalk with linseed oil. There are a number of synthetic alternatives, such as polybutene-based putties. On older windows, glazing putty is used to secure the panes of glass in the sashes or muntins. Newer windows do not normally have putty installed. Cracked, deteriorated or missing putty indicates an old window with delayed maintenance. Putty in poor condition may allow air drafts, rattling and water penetration. Sometimes, you will find silicone or caulk applied on older, single-pane windows in areas where the glazing putty is missing or in need of repair.



26.5 Weatherstripping

Window and door weatherstripping are generally of three types: metal, foam plastic, or plastic stripping. Each type should have a good fit. Check the metal for dents, bends and straightness. Check foam plastic for resiliency, and check plastic stripping for brittleness and cracks. Make sure the weatherstripping is securely held in place.

26.6 Fogged Windows

Almost all air contains water vapor, which is the gas phase of water composed of tiny water droplets. The molecules in warm air are far apart from one another and allow the containment of a relatively large quantity of water vapor. As air cools, its molecules get closer together and squeeze the tiny vapor droplets closer together, as well. A critical temperature, known as the dew point, exists where these water droplets are forced so close together that they merge into visible liquid in a process called condensation. Condensation is the accumulation of liquid water on relatively cold surfaces.

Household air is humidified from high levels of water vapor in human (and animal) exhalation, plant transpiration, and fixtures and appliances in the home, such as showers and clothes dryers. This humidity can rise significantly higher than that in the outside air because of the insulating design of a house. Cold indoor surfaces can cool the surrounding air enough to force vapor to condense. This often happens on single-pane windows because they lack the necessary thermal insulation available to newer and high-quality windows. Double-pane windows have a layer of gas (usually argon or air) trapped between the two panes of glass and should be insulated enough to prevent the accumulation of condensation. If this type of window appears misty or foggy, it means that its seal has failed and the window needs to be replaced.

Silica Desiccant

A desiccant is an absorptive material designed to maintain dryness within its vicinity. A common type of desiccant is silica gel, a porous plastic used to prevent spoilage in various food products. A tightly packed assortment of silica pellets is

contained inside the aluminum perimeter strip of a window to dehumidify incoming household air that was not stopped by the window's seal. If not for this substance, incoming air could condense on the glass.

Silica gel has an immense surface area (approximately 800 m^2/g), which allows it to absorb water vapor for years. Eventually, the silica pellets will become saturated and will no longer be able to prevent condensation from forming. A double-paned window that appears foggy has failed and needs to be replaced.

Why Double-Paned Windows Fail

Although double-paned windows appear to be stable, they actually experience a daily cycle of expansion and contraction caused by thermal pumping. Sunlight heats the air space between the panes and causes the gas there to heat up and pressurize. Expanding gas cannot leave the chamber between the panes, and this causes the glass to bulge outward during the day and contract at night to accommodate the changing pressures. This motion acts like the bellows of a forge, pumping minute amounts of air in and out of the air space between the panes. Over time, the constant pressure fluctuations caused by thermal pumping will stress the seal and challenge its ability to prevent the flow of gas in and out of the window chamber. If it is cold enough, incoming humid air has the potential to condense on the window surface.

Can Failed Windows Be Repaired?

Inspectors should be aware that there are companies that claim to be able to repair misty windows through a process known as "defogging."

This repair method proceeds in the following order:

1. A hole is drilled into the window, usually from the outside, and a cleaning solution is sprayed into the air chamber.
2. The solution and any other moisture are sucked out through a vacuum.
3. A defogger device is permanently inserted into the hole that will allow the release of moisture during thermal pumping.

Inspectors should know that there is currently a debate as to whether this process is a suitable repair for windows that have failed, or if it merely removes the symptom of this failure. Condensation appears between double-paned windows when the seal is compromised, and removal of this water will not fix the seal itself. A window "repaired" in this manner, although absent of condensation, might not provide any additional insulation. This method is still fairly new and opinions about its effectiveness range widely. Regardless, defogging certainly allows for cosmetic improvement, which is of some value to homeowners. It also removes any potential damage caused by condensation in the form of mold and rot.

Window condensation will inevitably lead to irreversible, physical window damage. This damage can appear in the following two ways:

1. riverbedding. Condensed vapor between the glass panes will form droplets that run down the length of the window. Water that descends in this fashion has the tendency to follow narrow paths and carve grooves into the glass surface. These grooves are formed in a process similar to canyon formation; and
2. silica haze. Once the silica gel has been saturated, it will be eroded by passing air currents, accumulating as white "snowflakes" on the window surface. It is believed that if this damage is present, the window must be replaced.

Thermal Imaging as a Detection Tool

The presence of condensation in double-paned windows means that they have failed, but the absence of condensation does not mean the window is functional. This latter fact is especially true in hot, dry environments and when the temperature inside of a house is the same as the temperature outside. A method has recently been developed that uses infrared (IR or thermal) imaging to provide a better determinant of faulty windows.

Home inspectors can become trained to use thermal imaging cameras to test for heat transfer through windowpanes and other interior locations. An IR camera can be used to identify failed windows by imaging unusual temperature gradients. Even the slightest entry of cold outside air into the home that would ordinarily go unnoticed will stand out as a dark blue haze in an IR image. A trained inspector can stand either outside or inside the house and watch for the escape of warm air or the entrance of cool air. A trained inspector can compare images of individual windows in a residence and look for anomalies.

Fogged Window Summary

In summary, condensation in double-paned windows indicates that the window has failed and needs to be replaced. Condensation, while it can damage windows, is itself

a symptom of a lack of integrity of the window's seal. A failing seal will allow air to transfer in and out of the window, even if it is firmly closed. Inspectors should be aware of this process and know when to recommend that clients' windows be replaced.

26.7 Shutters

Homeowners should periodically check the shutters' operation and observe their condition and fit, and confirm the adequacy of the shutters for their purpose: privacy, light control, security, and/or protection against bad weather.

Window shutters are generally of two types: decorative and functional. Decorative shutters are fixed to the exterior wall on either side of a window. Check the shutter's condition for change, and pay attention to its mounting to the wall. Functional shutters are operable and can be used to close off a window.

Shutters close to the ground can be examined from the ground. Shutters out of reach from the ground should be examined from inside the house. In hurricane regions, check shutters to see if the shutter manufacturer has certified them for hurricane use. If they provide protection to windows and glass doors, determine if they have been tested for impact-resistance to windborne debris.

26.8 Awnings

Check the condition of the awnings. The attachment to the exterior wall can become loose. An attachment device in the mortar joint of a brick wall that is in poor condition can be easily pulled or slid outward. Some windows and glazed exterior doors have awnings over them for sun control or protection from the weather, but some are decorative only. Awnings are usually made of metal, plastic or fabric on a metal or plastic frame. Some are fixed in place, while others are operable and can be folded up against the exterior wall. If an awning can be used for sun control, its effect on energy conservation is typically a personal judgment.

Section 27: Egress Doors

Egress Doors

Regardless of the size of the house, at least one egress door should be provided. The required door should provide access from the habitable portion of the home to the outside without going through a garage.

Door Measurement

The required door must be a side-hinged door, and it must be at least 3 feet wide and 6 feet and 8 inches tall. Other doors do not need to meet these minimum dimensions. They can be of any size and need not be a swinging-type.

All egress doors shall be readily openable from the inside without the use of a tool, a key, or special knowledge or effort. This standard permits a wide variety of hardware options.

Landing Width

The width of a landing should not be less than the door's width. The minimum dimension of every landing is 36 inches measured in the direction of travel.

Check the Floors or Landing at the Doors

On each side of each exterior door, there should be a floor or landing. The floor or landing should not be more than 1½ inches below the top of the threshold.

There are three exceptions:

1. If the door does not swing over the landing, then the exterior landing can be, at most, 7¾ inches below the top of the threshold. This is applicable to all exterior doors, including the required egress door. The screen and storm doors are allowed to swing over the landing. This is the most common exception.
2. If a stairway with, at most, two risers is at the exterior-side of a door, other than the required egress door, a landing on the outside is not required, provided the door does not swing over the stairway. Again, the screen or storm door is allowed to swing over the stairway.
3. A floor at all exterior doors, other than the required egress door, should not be more than 7¾ inches lower than the top of the threshold. It is also acceptable to raise the threshold of an exterior door, other than the egress door, up to 7¾ inches above the floor on the interior-side.

Section 28: Exterior Stairways and Ramps

28.1 Ramps

There are three main points to check at a ramp inspection. They are:

1. slope;
2. landings; and
3. handrails.

Slope

Ramps should not have a slope greater than 1 unit vertical in 12 units horizontal, or an 8.3% slope.

EXCEPTION: In areas where it is not possible to comply with the 1:12 slope, ramps may have a maximum slope of 1:8, or a 12.3% slope.

Landings

A minimum 3-foot by 3-foot landing should be installed in the following four locations:

1. at the top of the ramp;
2. at the bottom of the ramp;
3. where doors open onto ramps; and
4. where ramps change direction.

Handrails

There should be a handrail on at least one side of all ramps that have a slope greater than the 1:12 slope maximum. What is typically found is that most installers install

a handrail on all ramps, regardless of the slope.

The height of the ramp's handrail is measured from the finished surface of the ramp. The minimum is 34 inches, and the maximum is 38 inches.

Continuity

Handrails should be continuous for the full length of the ramp.

Termination

Handrails should end at a newel post, wall, or safety terminal.

Space

The space between a handrail at a ramp and the wall should be at least 1½ inches.

Length

The maximum rise for any run shall be 30 inches.

If the slope of a ramp is between 1:12 and 1:16, the maximum rise shall be 30 inches and the maximum horizontal run shall be 30 feet. If the slope of the ramp is between 1:16 and 1:20, the maximum rise shall be 30 inches and the maximum horizontal run shall be 40 feet.

28.2 Stairways

Ground Contact at Wooden Stairs

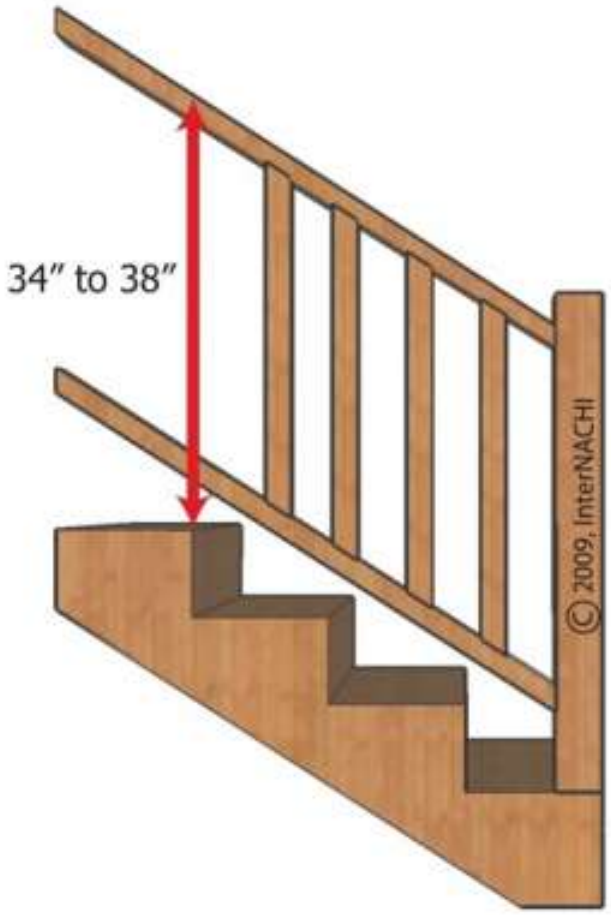
Exterior wood steps shall not be in direct contact with the ground unless suitably treated with a wood preservative. Wooden stair components in contact with the ground or in contact with concrete exposed to weather shall be of approved pressure preservative-treated wood suitable for ground-contact use.

Handrail

Any stairway of four or more risers should have a handrail on at least one side.

Handrail Height

The height of a handrail is measured vertically from the sloped plane adjoining the tread nosing or leading edge. The handrail height should be at least 34 inches, and not more than 38 inches.



Continuity

The handrail should be continuous for the full length of the flight of stairs, measured from a point directly above the top riser to a point directly above the bottom riser of the flight. Continuity can be interrupted by a newel post at a turn.

Attachment

The handrail should have attachment devices to transfer to the structural wall a concentrated load of 200 pounds applied at any point in any direction.

Width of the Stairway

Stairways should be at least 36 inches wide. This is measured at all points above the handrail height and below the required headroom height.

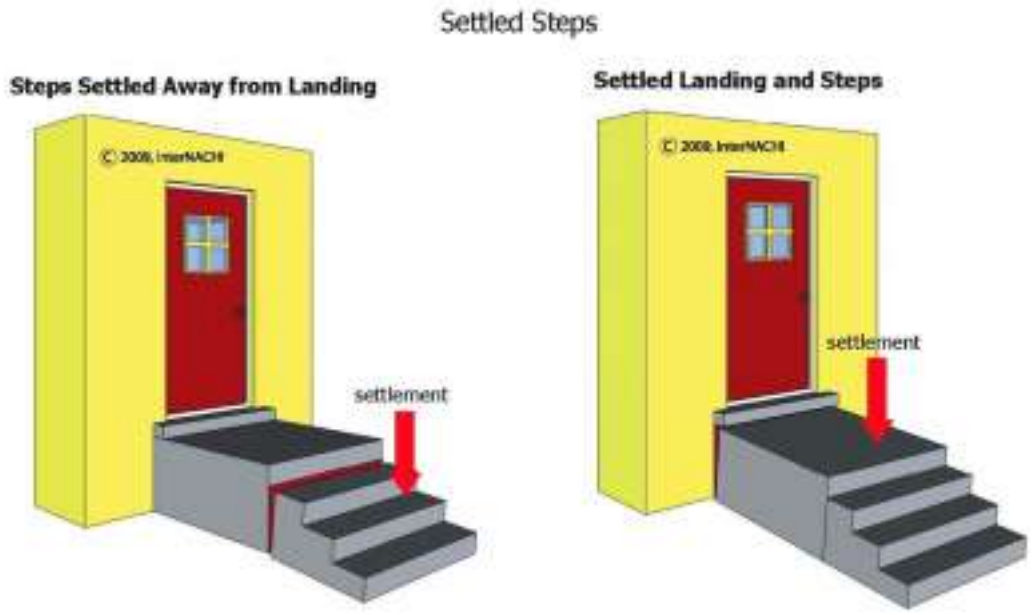
28.3 Risers and Treads

Risers

The minimum riser height is 4 inches, and the maximum is 7¾ inches. Any significant variation that would interfere with the rhythm of a person's natural stride should be avoided. The greatest riser height within any flight of stairs should not exceed the smallest by more than 3/8-inch.

Treads

The minimum tread depth is 10 inches. For winders, this is measured at the 12-inch walk line. The greatest tread depth within any flight of stairs should not exceed the smallest by more than 3/8-inch. The surface of the stairway treads (and landings) should not be greater than 1 unit vertical in 48 units horizontal, which is a 1/4:12 ratio, or a 2% slope.



On stairways with solid risers, there should be a nosing of at least ¾-inch, and not more than 1¼ inches. The radius of a nosing curve should be no greater than 9/16-inch. A nosing is not required when the tread depth is 11 inches or more.

28.4 Guards

Guards should be constructed to prevent adults from falling over them and to prevent children from crawling through them. The height of a guard is measured

vertically from the sloped plane adjoining the tread nosing or leading edge.

Guard Strength

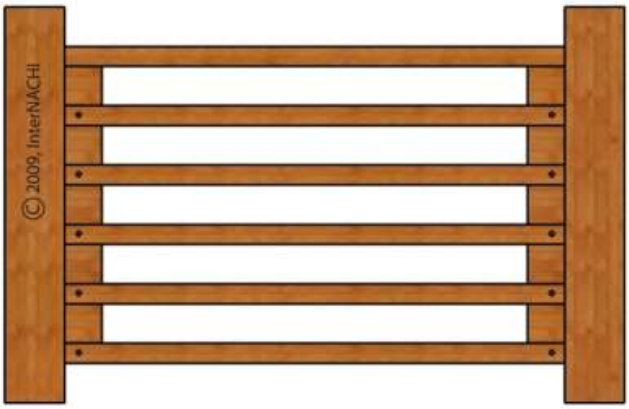
The design strength of a guard should resist a 200-pound concentrated load applied at any point in any direction along the handrail or the top of the guard. Intermediate rails and balusters should be able to withstand a horizontal load of 50 pounds on an area equal to 1 square foot.

Height

All decks and porches (including those with insect screening), landings, balconies, mezzanines, galleries, ramps, and raised-floor surfaces located more than 30 inches (1.2m) above the floor or ground should have guards. A guard is necessary at those elevated floor areas because a fall from that height can result in injury.

The minimum height of the horizontal guard should be 36 inches. Open sides of stairways with a total rise of more than 30 inches above the floor or ground should have guards not less than 34 inches in height.

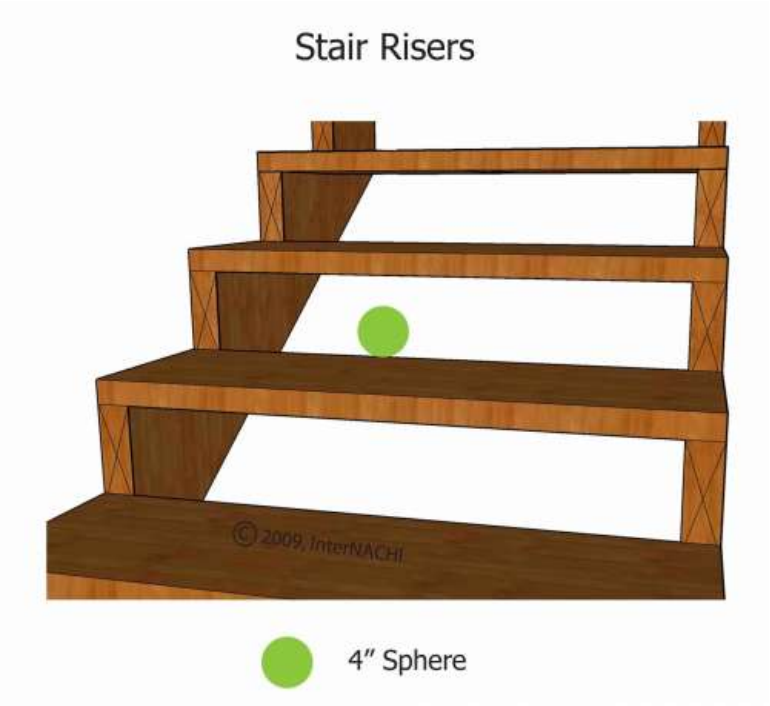
Ladder Effect



Guards should not have horizontal or ornamental patterns, members, attachments or openings that will facilitate climbing.

28.5 Spheres

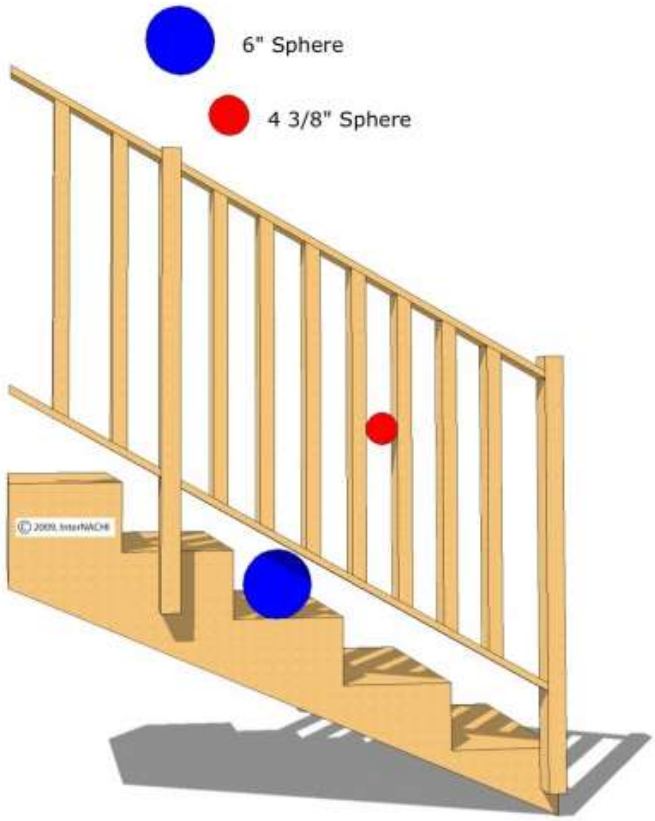
Horizontal guards at raised floor areas, balconies and porches should have intermediate rails or ornamental enclosures that do not allow the passage of a 4-inch-diameter sphere.



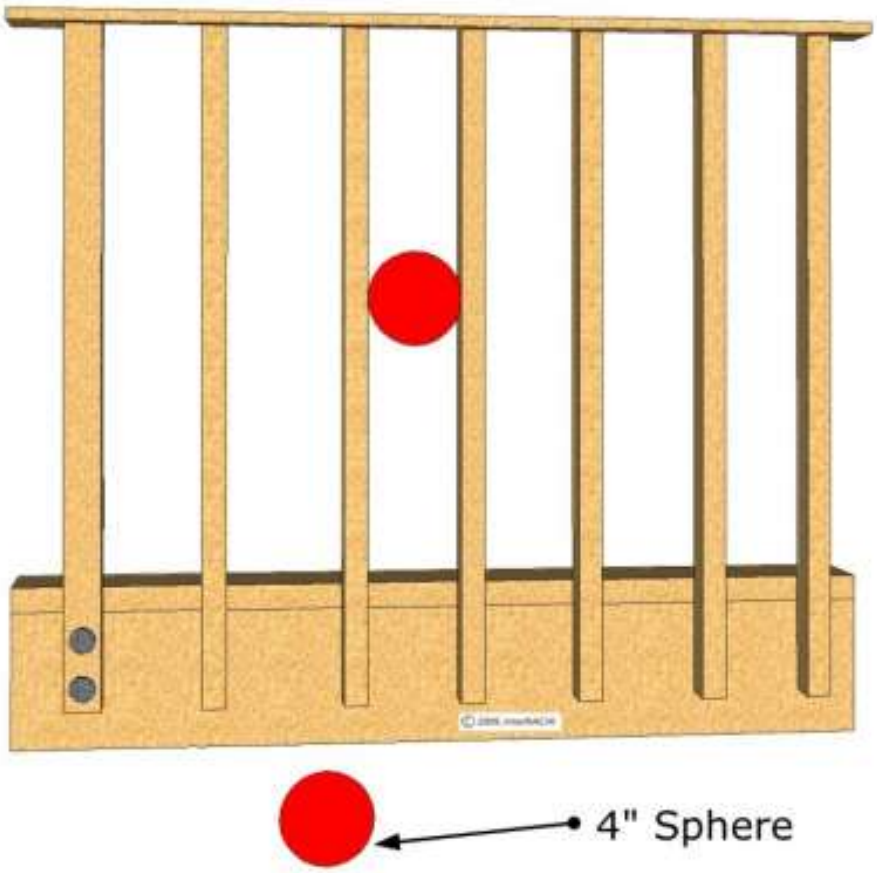
Open risers should not allow the passage of a 4-inch-diameter sphere. On stairs with a total rise of 30 inches or less, the size of the open riser is not limited.

The triangular area formed by a tread, riser and guard should not allow passage of a 6-inch-diameter sphere. (U.S.)

The opening at guards on the sides of stair treads should not allow the passage of a 4-3/8-inch-diameter sphere. (U.S.)



RAILING



For the U.S.: Horizontal guards at raised floor areas, balconies and porches should have intermediate rails or ornamental enclosures that do not allow passage of a 4-inch diameter sphere.

For Canada: Openings through any guard shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm, unless it can be shown that it will not represent a hazard.

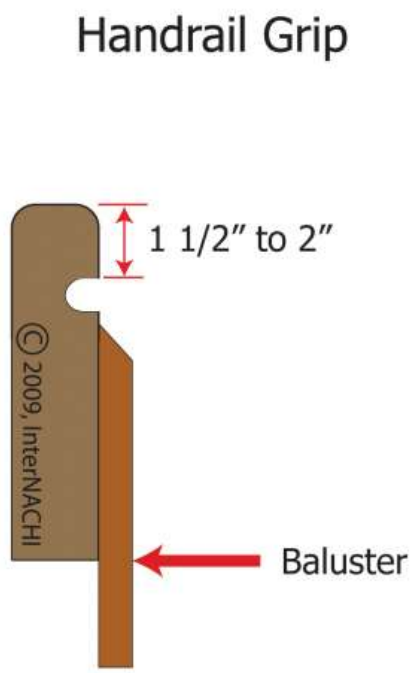
For the U.S.:

- Open risers should not allow the passage of a sphere 4 inches in diameter. On stairs with a total rise of 30 inches or less, the size of the open riser is not limited.

- The triangular area formed by a tread, riser and guard should not allow passage of a sphere 6 inches in diameter.

- The opening at guards on the sides of stair treads should not allow the passage of a sphere 4-3/8 inches in diameter.

28.6 Handrail Grip



The handrail grip (or handgrip) should be graspable along the entire length of the handrail. The handgrip shape should provide a graspable surface. It should allow the user to maintain a consistently secure and natural grasp on the handrail, without twisting the fingers or requiring release. The handgrip can be circular or non-circular.

28.7 Attachment

Required egress stairways, decks, balconies, and similar means of egress should be anchored to the primary structure to resist both vertical and lateral forces. The use of toenails or nails subject to withdrawal is not permitted.

28.8 Emergency Escape-and-Rescue Openings

An exterior window, egress door, or similar component can serve as a means of escape and access for rescue in case of an emergency.

Check for a Required Opening

It will be difficult to determine whether a window is a required emergency escape-and-rescue opening. While moving around the exterior of the house, check all

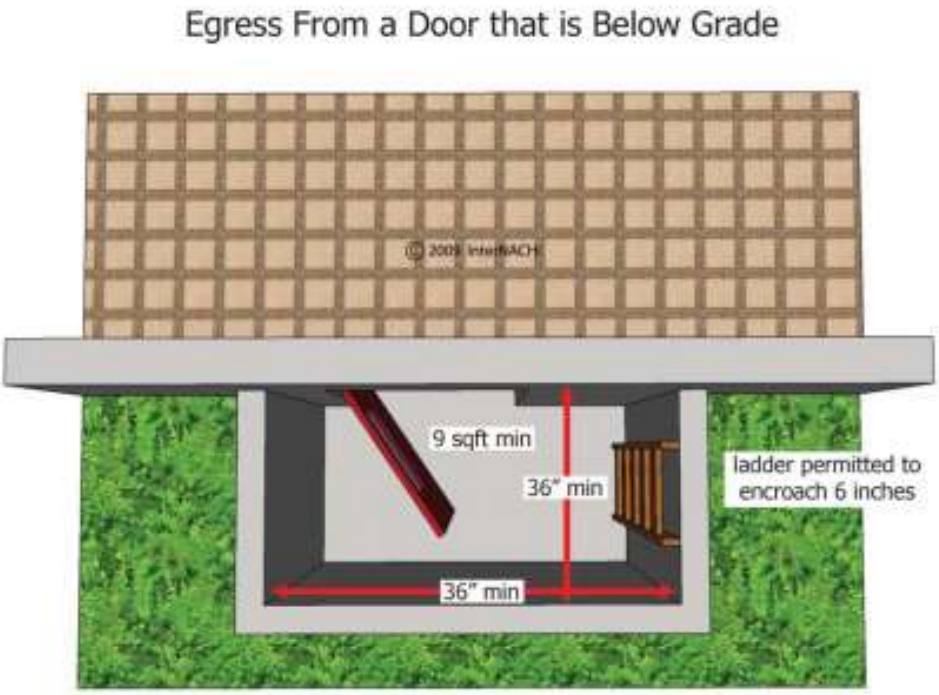
lower-floor and basement windows while keeping in mind this potential requirement. Before completely understanding which rooms have which types of windows and related requirements, you may have to go into the lowest level of the house and finish the interior inspection. To completely inspect a particular window, door or egress opening, you have to inspect that component from both sides. You may find yourself going back and forth, inside and outside a house, to complete your inspection of a basement that has issues related to a required egress door or window.

Basements and every sleeping room should have at least one emergency escape-and-rescue opening. Such openings should open directly onto a public street, public alley, yard or court.

The emergency escape-and-rescue opening should be operational from the inside without the use of tools, keys, or special knowledge.

28.9 Window Wells

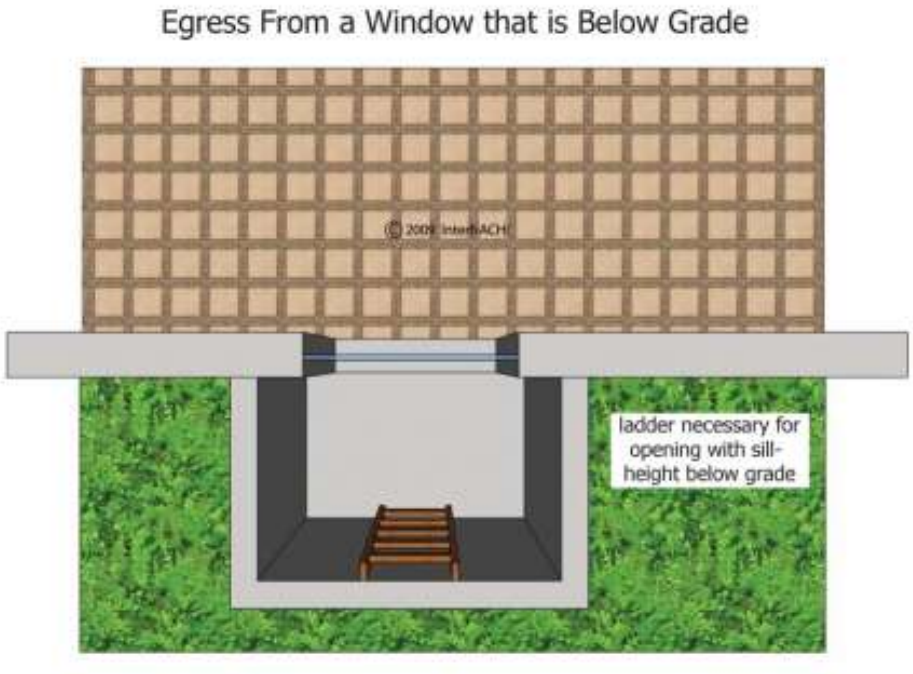
The horizontal area of the window well for an emergency escape-and-rescue opening should be at least 9 square feet. It should have a horizontal projection and width of at least 36 inches each way.



EXCEPTION: Ladders or steps may project into the space 6 inches.

Ladders or Stairs

Wells with a vertical depth of at least 44 inches should have a permanent ladder or steps, with an inside width of 12 inches minimum, and at least 3 inches from the wall, and should be spaced no greater than 18 inches apart vertically.



Bulkhead

Bulkheads should be checked. Open the bulkhead. When you open it to its fully-open position, it should meet the minimum net-clear opening requirements.

Covers

Bars, grilles, covers and screens are permitted over the opening, provided that the minimum net clear opening requirements are met. Such devices should be

removable from the inside without the use of a key, tool, special knowledge, or force greater than that which is needed for normal operation of the emergency escape-and-rescue opening.

Decks and Porches

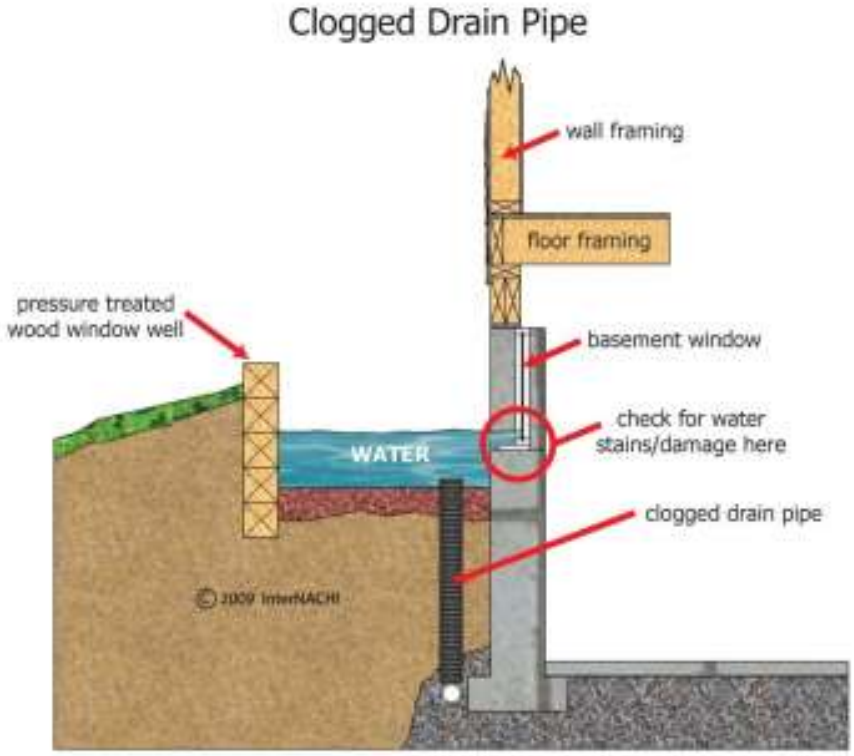
Emergency escape-and-rescue openings are allowed to be under decks and porches, provided that the opening can still be fully opened, and there is an egress path of at least 36 inches in height to a yard or court.

28.10 Basement Walkouts

A typical basement walkout is a below-grade entrance to a basement. There should be a set of stairs and a landing at the bottom of the stairs. The walls and steps of a walkout are commonly made of concrete, but can be made of a variety of materials, including wood. A walkout may be covered with a permanent roof structure, or it may be open. The walkout may have a cover that can be opened or removed.

Drainage Provision

If the walkout is not covered and is open to rainfall or water penetration, then a drain provision is needed at the bottom of the walkout stairway. Sometimes, there is a drainage grate or track in front of the tread of the door. Rainfall and snow can fill up an open walkout that has drainage problems. Overflowing gutters may also deposit a lot of water into an open walkout.



Drains at the bottom of the walkout stairway usually do not have traps because the outdoor traps may freeze in the cold winter. Instead of seeing a trap fitting, you may see part of a pipe that extends toward a floor drain that has a trap. That drain would be located within the house's perimeter, where it is warm. This allows the outside drain at the bottom of a walkout stairway to use a water trap of a floor drain.

The drain may be connected to the underground drainage provision of the foundation perimeter. On a sloped lot, the drain may simply discharge out to grade, away from the house.

The drain may be missing, damaged, cracked, open and not covered with a grille or grate piece, clogged, filled with water, or under repair.

When inspecting a walkout, check for the following:

- cracks in the walls of the walkout stairway;
- leaning or bowing of the walls;
- cracking or heaving steps;
- cracking, settlement or heaving of the landing at the bottom of the stairway;
- the presence of drainage at the bottom of the stairway;
- surface drainage around the walkout; and
- clogging or failure of the drain.

Drainpipe

A walkout drain and drainpipe should be at least 3 inches in diameter. If the drain appears smaller than that, you may report it as being an installation defect and presently unreliable.

Threshold

A good building practice is to have a door threshold or curb at the basement walkout. The threshold could be 4 to 6 inches high. It is a component that essentially raises the door tread or sill above the walkout’s floor level. This will assist in preventing water from entering through the door's opening. The first line of defense against water intrusion, however, is a functional drainage provision.

Walkout Bulkheads or Manufactured Covers

Many walkouts do not have covers. Some have one or two manufactured hinged doors. While performing the exterior inspection, check the cover or doors. If it's locked, you'll have to delay your inspection until you can get into the basement to unlock it. Check for damage, rust, rot, hinge condition, the surface condition of the cover or door, and how well it operates. Once open, a manufactured door over a bulkhead walkout should stay and remain open by itself. Check to see if this safety feature is present. If it is not, you may report it as a concern.

Quiz 15

A sill at a window or door should be _____.

- sloped
- level
- stainless steel
- painted

Window _____ in poor condition may allow air drafts, rattling and water penetration.

- putty
- glass
- rails
- locks

T/F: Fogged windows should be replaced.

- True
- False

Regardless of the size of the house, at least one _____ door should be provided.

- egress
- steel
- side
- laundry
- wooden

T/F: The required door must be a side-hinged door at least 4 feet wide and 6 feet, 8 inches tall.

- False

- True

T/F: Typically, ramps should not have a slope greater than 1 unit vertical in 12 units horizontal.

- True
- False

T/F: Any stairway of four or more risers should have a handrail on at least one side.

- True
- False

If the walkout is not covered and is open to rainfall or water penetration, then a _____ provision is needed at the bottom of the walkout stairway.

- drainage
- sealant
- clogging
- debris
- stepping

Section 29: Exterior Structures

Exterior Structures

This section covers exterior structures, including decks, balconies, porches, garages, and more. Components of these structures include steps, railings, columns and beams. Inspectors should be aware of some of the common problems found at these exterior structures, the implications of problems, and how to inspect for such conditions.

Decks, porches, balconies, verandas and patios are outdoor architectural elements that are often confused with one another. An explanation of their intended use, history and design allow for useful distinctions, although a certain degree of exception and overlap is unavoidable.

Be sure to check out InterNACHI's How to Perform Deck Inspections course.

Decks

A typical deck is a large, raised wooden floor attached to the back of a house and contained by a perimeter railing for safety. Decks are rarely covered, and usually

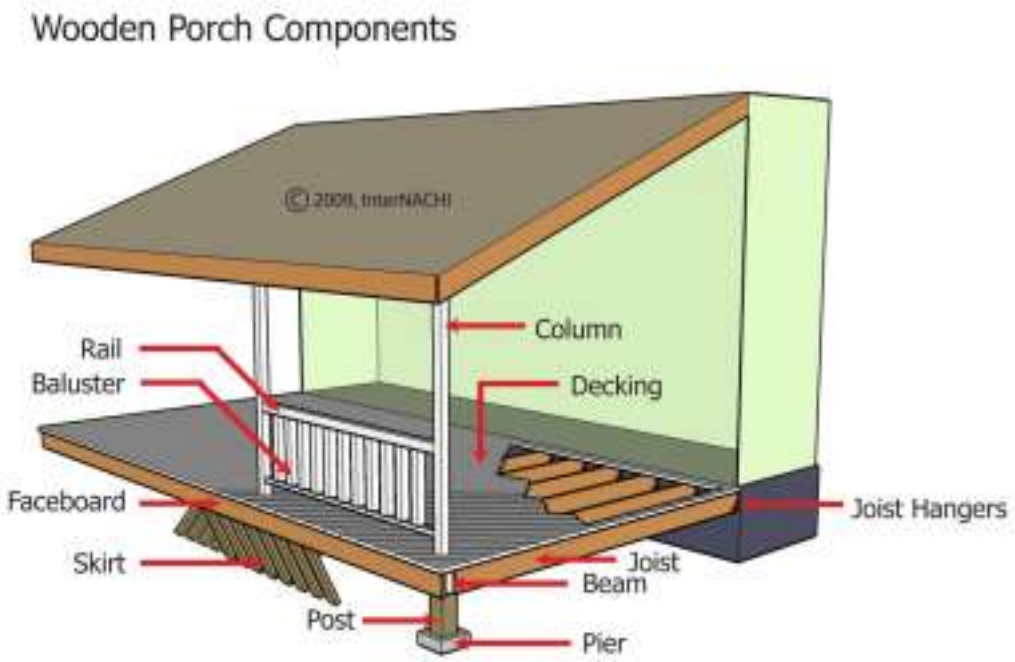
have a rough or informal look that is not integrated with the rest of the house's design. They are usually slightly raised above the ground surface. The floor system is open to allow water to pass through. Decks are usually supported by posts and the house wall or foundation. They are typically intended to be locations for large outdoor social gatherings, such as barbecues and birthday parties. Access to the deck may be from the ground through a stairway, or from the house through a back door.

Deck Facts:

- The word "deck," in this context, is generalized from decks on a ship.
- It originates from the Middle Low German word *verdeck,* meaning "covering."
- The first commercial boardwalk in the United States, which is considered a deck, was built in Atlantic City, New Jersey.

Porches

A porch is a wooden structure that forms a covered entrance to a doorway at



ground level. A porch is usually located at the front of the house. A typical porch has a roof, steps and a guardrail around it. The porch usually has outdoor furniture set on it. Porches and their roof structures are supported by posts or columns and the house wall or foundation.

Porch Facts:

- Porches are used as anterooms where muddy shoes and wet clothes can be shed before entering the house.
- The word "porch" originates from the Latin word *porta,* which means "gate" or "entrance."
- While many houses in the southern United States, as well as Victorian-style houses, have large porches suitable for social gatherings, most modern porches are too small for comfortable social use, and merely add to the visual appeal of the building.
- Porches are typically integrated with the house's architecture by using similar design elements.

Balconies

A balcony is a platform that protrudes from the wall of an upper floor of a building and is enclosed by a guardrail. Balconies are usually at least one story-level above the ground surface. Balconies are often highly decorative, especially in wealthy and scenic areas. They are not designed as social areas but, rather, add an outdoor ambiance to the indoors. Access is by an interior door. There are no steps. There is no access to the ground level.

Balconies can be supported by columns and the house wall. They can be supported by tension structural members. Balconies can be supported underneath by structural brackets, or they can be cantilevered.

Balcony Facts:

- In William Shakespeare's "Romeo and Juliet," Juliet famously courted Romeo from her balcony. The small balcony design typically associated with that scene is often referred to as a "Juliet balcony."
- Balconies can be large enough to resemble decks, but they do not provide access to the ground.
- "Balcony" originates from the Italian word *balcone,* which means "large window."
- Balconies can be made from wood, iron, stone, and many other masonry materials.

Verandahs

A verandah (or veranda) is a long, roofed, open gallery built around a central structure, and supported by pillars. Verandahs are often long enough to extend around the front and sides of a structure. Their origins are uncertain, but they are known to be a hybrid of East Indian and European styles. The purpose of the verandah is social, although in a more relaxed, everyday sense than is the case of a deck or patio.

Verandah Facts:

- "Verandah" is alternately spelled “veranda.”
- *Verandah* appears in Hindi and several other native Indian languages, although it appears to be an adaptation of the Portuguese and Spanish *baranda.*
- Australia and New Zealand have their own unique style of verandah. Some verandahs in these countries are roof-like structures that surround commercial buildings, often on every floor. Their purpose is to provide protection from the sun.

Patios

A typical patio is a paved, roofless surface adjoining a residence that is generally intended for dining and recreation. These open-air living spaces are at ground level and are usually made from cement, stone, slate, or a combination of these materials.

Patio Facts:

- "Patio" originates from the Latin word *patere*, meaning “to lie open.”
- *Patio* is Spanish for “backyard” or “back garden."
- In Australia, a patio often refers to any kind of outdoor verandah or balcony.

Section 30: Inspecting Decks

Inspecting Decks

This section deals with some of the details of a deck inspection that may be performed during an inspection of the exterior. It is excerpted from InterNACHI's comprehensive Deck Inspections course and book.

At the end of this section, you should be able to:

- know how to inspect a deck; and
- list some common concerns related to a deck structure.

More than 2 million decks are built and replaced each year in North America. InterNACHI estimates that of the 45 million existing decks, only 40% are completely safe.

Because decks appear to be simple to build, many people do not realize that decks are, in fact, structures that need to be designed to adequately resist certain stresses. Like any other house or building, a deck must be designed to support the weight of people, snow loads, and objects. A deck must be able to resist lateral and uplift loads that can act on the deck as a result of wind or seismic activity. Deck stairs must be safe and handrails graspable. And, finally, deck rails should be safe for children by having proper infill spacing.

A deck failure is any failure of a deck that could lead to injury, including rail failure, or total deck collapse. There is no international system that tracks deck failures, and each is treated as an isolated event, rather than a systemic problem. Very few municipalities perform investigations into the cause of a failure, and the media are sometimes more concerned with injuries rather than the causes of deck collapses. Rail failure occurs much more frequently than total deck collapses; however, because rail failures are less dramatic than total collapses and normally don't result in death, injuries from rail failures are rarely reported.

Here are some interesting facts about deck failure:

- More decks collapse in the summer than during all the other seasons combined.
- Almost every deck collapse occurred while the decks were occupied or under a heavy snow load.
- There is no correlation between deck failure and whether the deck was built with or without a building permit.
- There is no correlation between deck failure and whether the deck was built by a homeowner or a professional contractor.
- There is a slight correlation between deck failure and the age of the deck.
- About 90% of deck collapses occurred as the result of the separation of the deck from the house via the deck ledger board, allowing the deck to swing away from the house. It is very rare for deck floor joists to break mid-span.
- Many more injuries are the result of rail failure, rather than complete deck collapse.
- Deck stairs are notorious for lacking graspable handrails.
- Many do-it-yourself homeowners, and even contractors, don't believe that rail infill spacing codes apply to decks.

This section does not address specific building codes, balconies, lumber species, grade marks, decks made of plastics or composites, mold, or wood-destroying insects. This section focuses on single-level residential wood decks. Recommendations found within this section exceed the requirements of InterNACHI's Standards of Practice for Performing a General Home Inspection.

A proper deck inspection relies heavily on the professional judgment of the inspector. The following information will help improve the accuracy of the inspector's observations.

Required Deck Inspection Tools:

- flashlight;
- measuring tape;

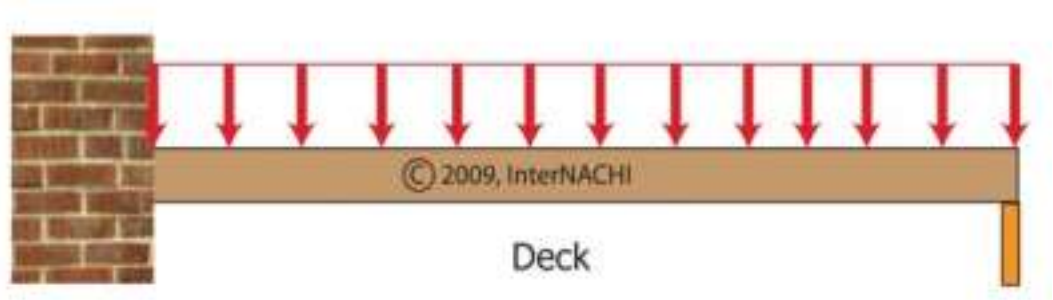
- ladder;
- level;
- plumb bob;
- probing tool; and
- hammer.

Optional Inspection Tools:

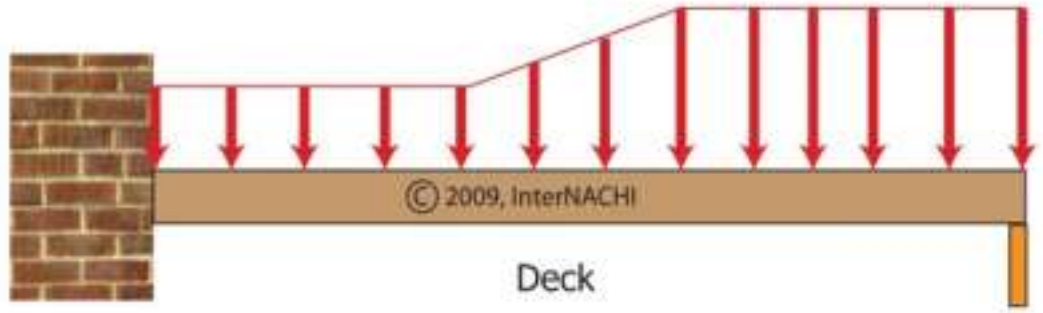
- moisture meter;
- magnet; and
- calculator.

Deck Loads

A deck inspection should progress in much the same order as deck construction. Inspectors should start at the bottom. If a deck is deemed unsafe from underneath, the inspector should not walk out onto the deck to inspect decking, handrails, etc. The inspector should stop and report the safety issues.



The image above depicts an evenly distributed deck load. Building codes require decks to be designed to carry a uniformly distributed load over the entire deck. If evenly distributed, half of the load is carried by the deck-to-house connection, and the other half is carried by the posts.



The image above depicts a likely deck load distribution. People tend to gather near the railings of a deck, and so more load is likely carried by the posts.

Hot tubs filled with water and people are heavy and can weigh a couple of tons. Most decks are designed for loads of 40 to 60 pounds per square foot. Hot tubs require framing that can support more than 100 pounds per square foot.

Footings and Posts

Required footing depths vary based on local building codes. The depth is normally below the frostline, or 12 inches where frostlines are not applicable.

On steep properties, the slope of the ground around the footing could affect the footing's stability. The "7-Foot Rule" states that there should be a least 7 feet between the bottom of a footing and daylight.

Posts in contact with soil should be pressure-treated and oriented so the cut end is above grade.

The footing near the home may not be placed on undisturbed soil. Some codes consider soil to be undisturbed if it hasn't been disturbed in more than five years.

Posts can lift out of pre-cast concrete piers, and piers can slide. Posts should be connected to their footings so that the posts don't lift up or slip off.

Lawn sprinkler systems that regularly keep the deck wet contribute to decay of wooden components. Downspouts should not discharge near deck posts. Puddles contribute to post decay. Wood can decay and degrade over time with exposure to the elements. Decay is a problem that worsens with time. Wooden members within the deck frame that have decayed may no longer be able to perform the function for which they were installed. Paint can hide decay from an inspector, so it should be noted in the report.

The inspector should use the "pick test" to test for wood decay. This involves the use of an ice pick, awl or screwdriver to penetrate the wood surface. After penetrating the wood, the tool is leveraged to pry up a splinter parallel to the grain

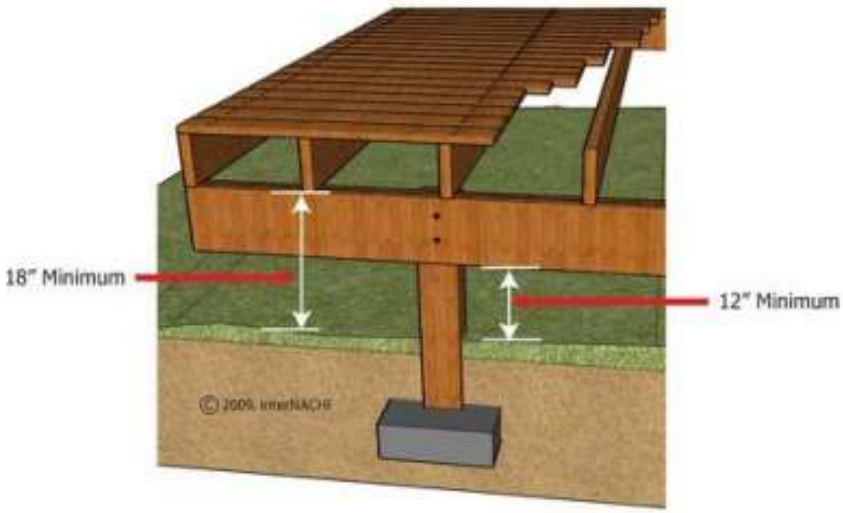
and away from the surface. The appearance and sound of the action is used to detect decay. The inspector should first try the pick test in an area where the wood is known to be sound to determine a control for the rest of the inspection. Decayed wood will break directly over the tool with very few splinters and little or almost no audible noise, compared to sound wood. The pick test cannot detect decay far from the surface of the wood.

Although deck inspections are visual-only inspections, inspectors may want to dig down around posts and perform pick tests just below grade level to look for decay.

Tall 4x4 posts twist under load, and 4x4 posts, even when treated, tend to decay below grade very quickly. In all but the lowest of decks, deck posts should be at least 6x6, and be no higher than 12 feet; 14 feet is acceptable if cross-bracing is used.

Decks higher than 6 feet above grade that do not have diagonal decking should have diagonal bracing across the bottoms of the joists to keep the decking square. A deck that is not held square could permit the outer posts to lean to the right or left and parallel to the ledger board, and thus twist the ledger away from the home.

Girders and Beams



The image left depicts the minimum distance of untreated support members from grade. Untreated joists should be at least 18 inches above the ground. Girders should be 12 inches above the ground. However, in many situations, exceptions are made where the elevation of the home does not provide for these minimum distances and the climate is very dry.

Ledger Connection

The most common causes of deck collapse are ledgers that pull away from the band joists of homes and buildings.

The two most common ways to correctly attach a ledger to a structure are with lag screws or through-bolts. The installation of through-bolts requires access to the back-side of the rim joist, which, in some cases, is not possible without significant removal of drywall within the structure.

Most building codes state that, where positive connections to the primary building structure cannot be verified during inspection, decks shall be self-supporting (freestanding).

Determining the exact required spacing for the ledger fasteners is based on many factors, including:

- joist length;
- type of fastener;
- diameter of fastener;
- sheathing thickness;
- the use of stacked washers;
- wood species;
- moisture content of the wood;
- integrity of the band joist; and
- deck loads...

...and so is beyond the scope of a visual inspection. However, the number of ledger fasteners required is primarily determined by the length of the joists. InterNACHI's ledger-fastener spacing formula provides inspectors with this rule of thumb:

On-center spacing of ledger fasteners in inches = 100 ÷ joist length in feet.

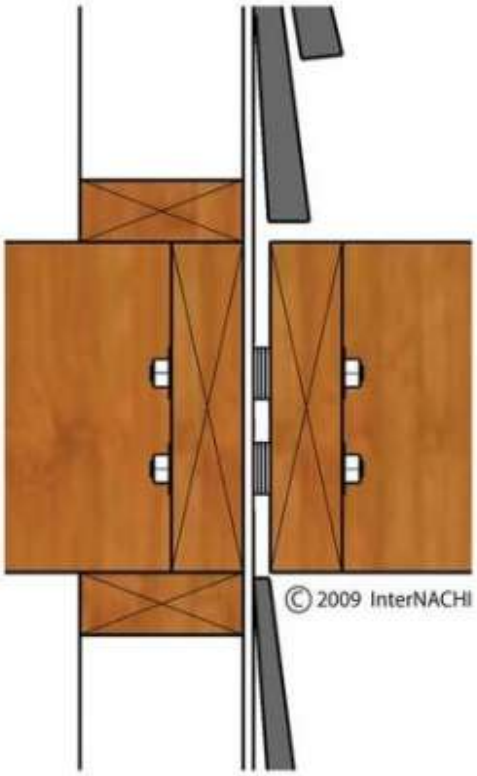
A deck with substantially fewer ledger fasteners than that recommended by InterNACHI's formula may be unsafe.

The image above shows the minimum distance of fasteners to the edges and ends of a ledger board. Lag screws or bolts should be staggered vertically, placed at least 2 inches from the bottom or top, and 5 inches from the ends of the ledger board. Some codes permit the lag screws or bolts to be as close as 2 inches from the ends of the ledger board; however, avoiding the very ends of the ledger boards minimizes splitting from load stress.

Through-bolts should be a minimum of ½-inch in diameter and have washers at the bolt head and nut. Lag screws should also be a minimum of ½-inch in diameter and have washers. Expansion and adhesive anchors should also have washers.

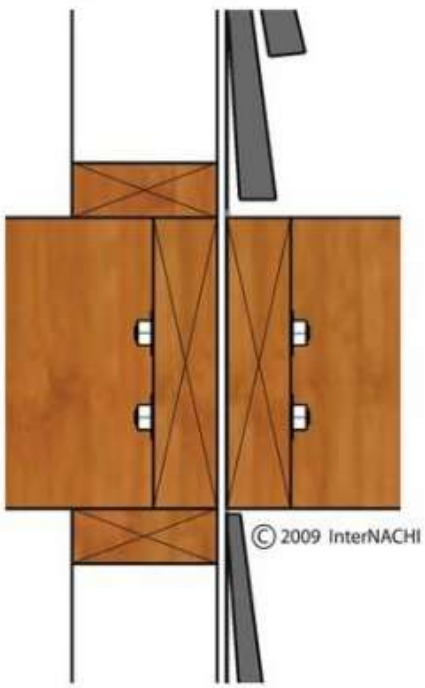
Deck ledgers should be comprised of pressure-treated wood that is at least 2x8.

Ledger Board and Band Joist Contact



The image right depicts washers being used as spacers between the ledger board and band joist, which is incorrect.

In some cases, the ledger board and band joist are intentionally kept separated by a stack of washers on the lag screws or bolts to allow water to run between the two boards. In other cases, there is insulation between the two boards. Even worse is when the siding or exterior finish system was not



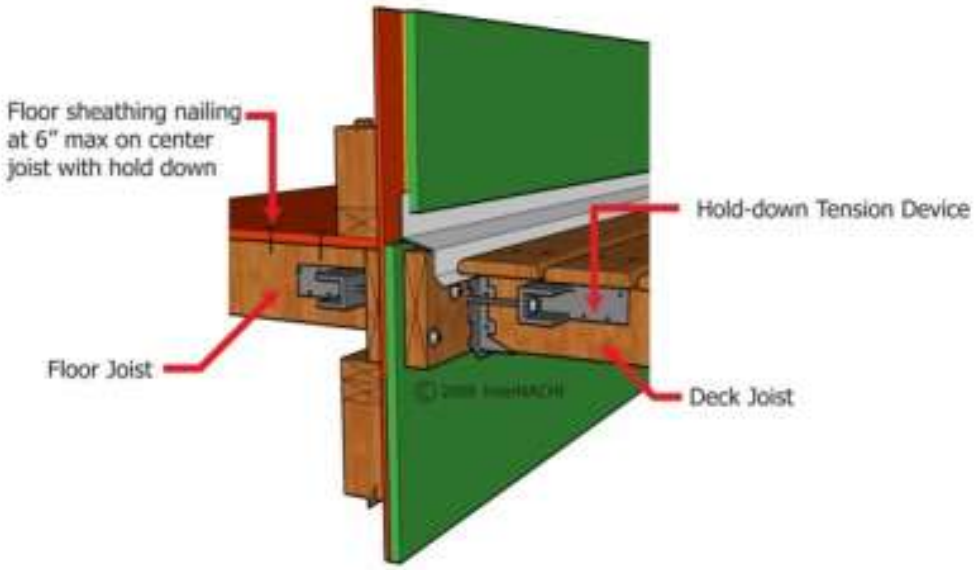
removed prior to the installation of the ledger board. Situations where the ledger board and band joist are not in direct contact significantly reduce the strength of the ledger connection to the structure and are not recommended by InterNACHI, unless the two members are sandwiching structural sheathing.

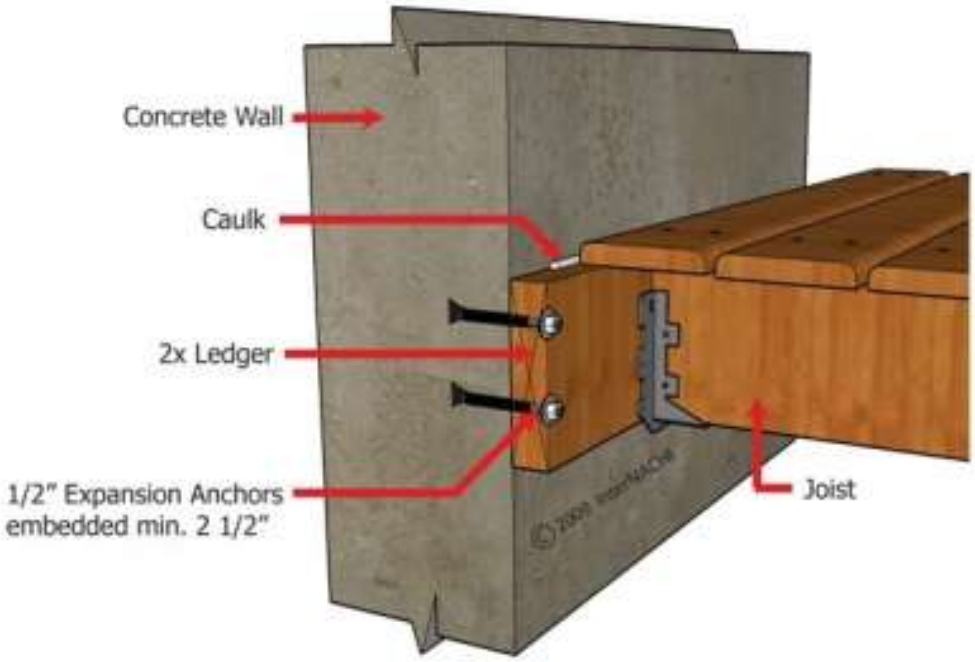
The image left depicts a ledger board and band joist sandwiching the structural sheathing. This is a correct installation.

All through-bolts should have washers at the bolt head and nut.

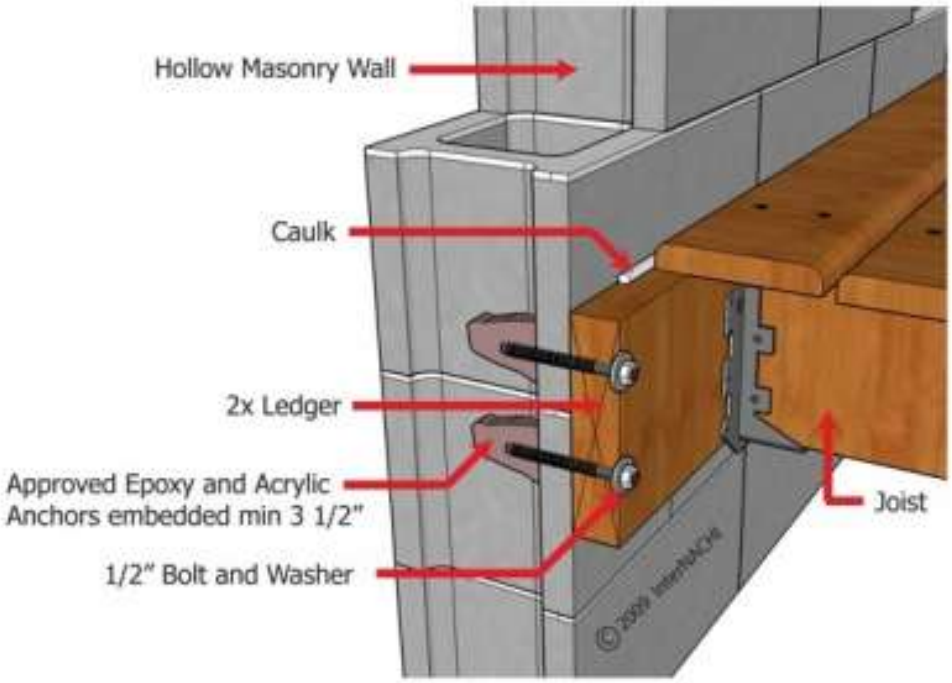
The image below depicts a hold-down tension device. The 2007 IRC Supplement requires hold-down tension devices at no fewer than two locations per deck.

Codes in some areas outright forbid attaching a ledger board to an open-web floor truss.



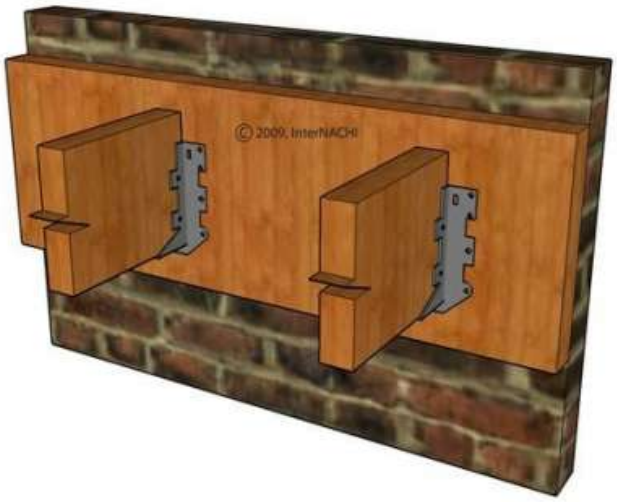


The image above depicts a ledger board attached to a concrete wall. Caulking rather than flashing is used.



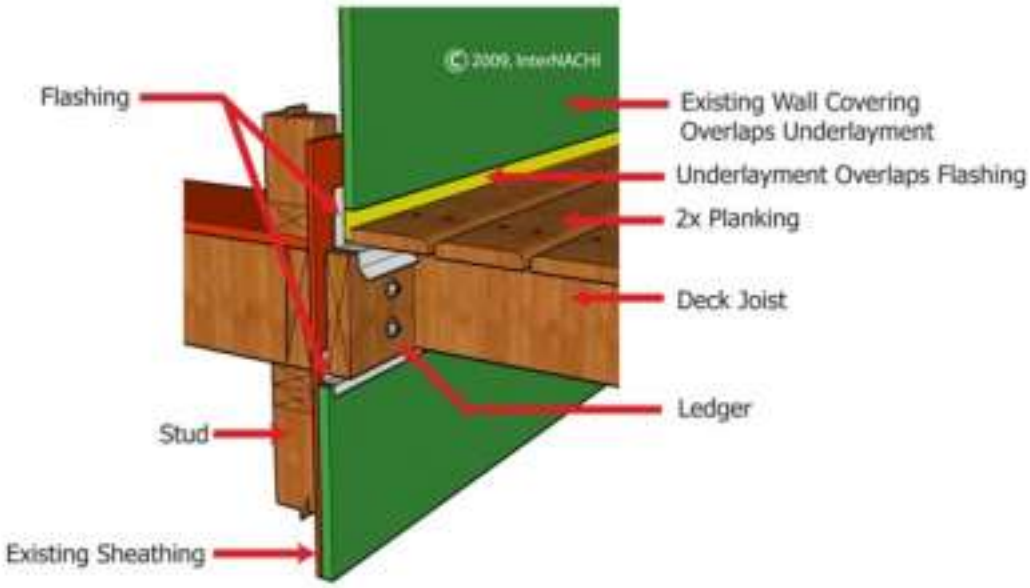
The image above depicts a ledger board attached to hollow masonry. When the ledger is attached to a hollow masonry wall, the cell should be grouted.

The image right depicts a ledger board improperly supported by brick veneer. Ledger boards should not be supported by stone or brick veneer.



Ledger boards should not be attached directly (surface-mounted) to stucco or EIFS, either. Stucco and EIFS have to be cut back so that ledger boards can be attached directly to band joists. However, cut-back stucco and EIFS are difficult to flash and weather-proof.

Ledger Board Flashing



The image above depicts both over and under ledger board flashing. The ledger board should always be flashed even when the home or building has a protective roof overhang.

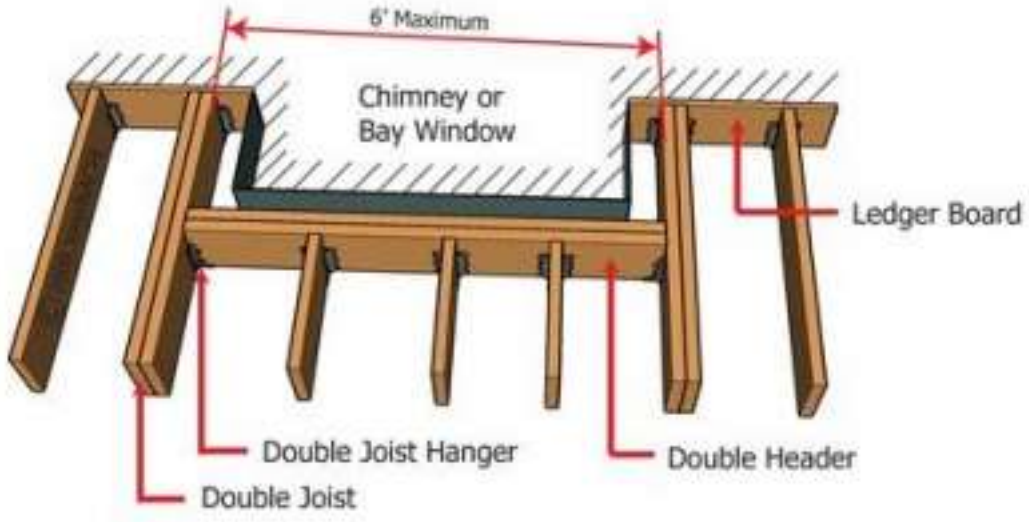
Aluminum flashing is commonly available but should not be used. Its contact with pressure-treated wood or galvanized fasteners can lead to rapid corrosion of the aluminum.

The image left depicts a deck ledger attached to an overhang. Decks should not be attached to overhangs.

The image below depicts proper framing for around chimneys and bay windows that are up to 6 feet wide. Framing around chimneys and bay windows that are more than 6 feet wide requires additional posts.

Cracks

As wood ages, it is common for cracks to develop. Large cracks (longer than the depth of the member) or excessive cracking overall can weaken deck framing. Toe-nailed connections are always at risk for splitting. Splitting of lumber near connections should be noted by the inspector.



Connectors and Fasteners

The inspector should note missing connectors and fasteners. All lag screws and bolts should have washers.

Depending on how the deck was built, vital connections may have degraded over time due to various factors. Issues such as wobbly railings, loose stairs, and ledgers that appear to be pulling away from the adjacent structure are all causes for concern. The tightness of fasteners should be checked. If it is not possible to reach both sides of a bolt, it may be struck with a hammer. The ring will sound hollow with vibration if the fastener is loose. The ring will sound solid if the connection is tight. The hammer test is subjective, so the inspector should hammer-test bolts that can be confirmed as tight or loose, and compare the sounds of the rings to develop a control.

Corrosion of Connectors and Fasteners

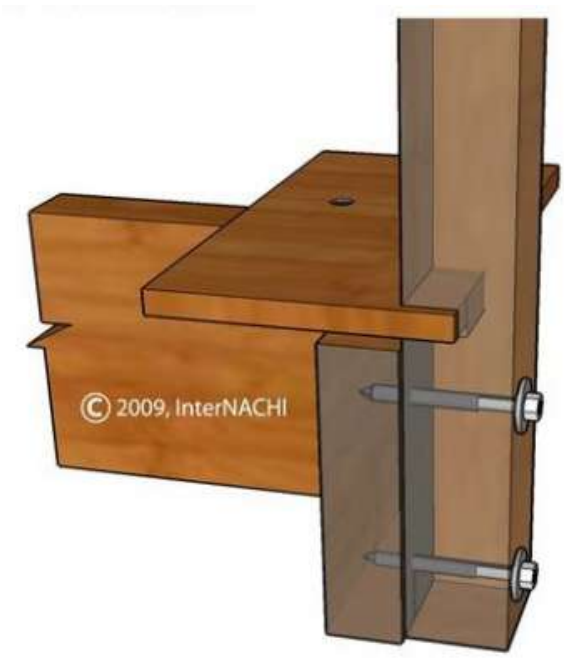
All screws, bolts and nails should be hot-dipped galvanized, stainless steel, silicon bronze, copper, zinc-coated or corrosion-resistant. Metal connectors and fasteners can corrode over time, especially if a product with insufficient corrosion resistance was originally installed. Corrosion of a fastener affects both the fastener and the wood. As the fastener corrodes, it causes the wood around it to deteriorate. As the fastener becomes smaller, the void around it becomes larger. Inspectors normally do not remove fasteners to check their quality or size, but if the inspector removes a fastener, s/he should make sure that removal doesn't result in a safety issue. Fasteners removed should be from areas that have the greatest exposure to weather. Some inspectors carry new fasteners to replace ones they remove at the inspection.

POSTS and RAILS

Missing Posts

You might find a guardrail improperly supported solely by balusters. Guardrails should be supported by posts every 6 feet.

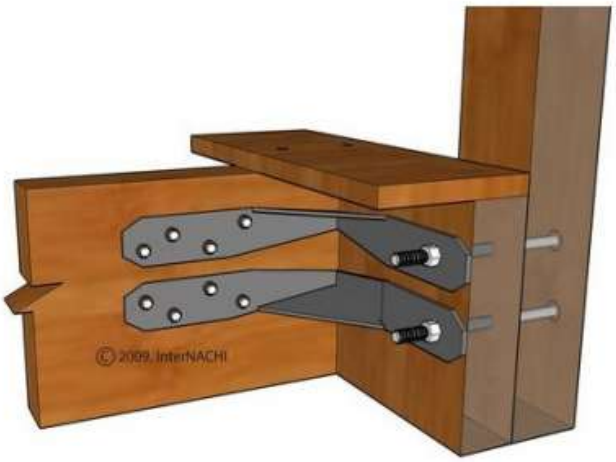
The image right depicts a notched-deck guardrail post attachment. This common notched-type of attachment is permitted by most codes, but could become unsafe, especially as the deck ages. Because of leverage, a 200-pound force pushing the deck's guardrail outward causes a 1,700-pound force at the upper bolt attaching the post. It is difficult to attach deck guardrail posts in a manner that is strong enough without using deck guardrail post brackets.



Notched Guardrail Post

The image left depicts a notched-deck guardrail post attachment. This notched-around-decking-type of attachment is permitted by most codes, but it could become unsafe, especially as the deck ages. Because of leverage, a 200-pound force pushing the deck's guardrail outward causes a 1,700-pound force at the upper bolt attaching the post. It is difficult to attach deck guardrail posts in a manner that is strong enough without using deck guardrail post brackets.

The image right depicts a deck guardrail post properly attached with brackets. Because of leverage, a 200-pound force pushing the deck's guardrail outward causes a 1,700-pound force at the upper bolt attaching the post. It is difficult to attach deck guardrail posts in a manner that is strong enough without using deck guardrail post brackets.



Level-Cut Posts and Balusters

The end grain of vertical posts and balusters should not be cut level. The image right depicts a post and balusters properly cut at angles in order to shed water. The end grain of vertical posts and balusters should be cut at an angle.

Improper Guardrail Height

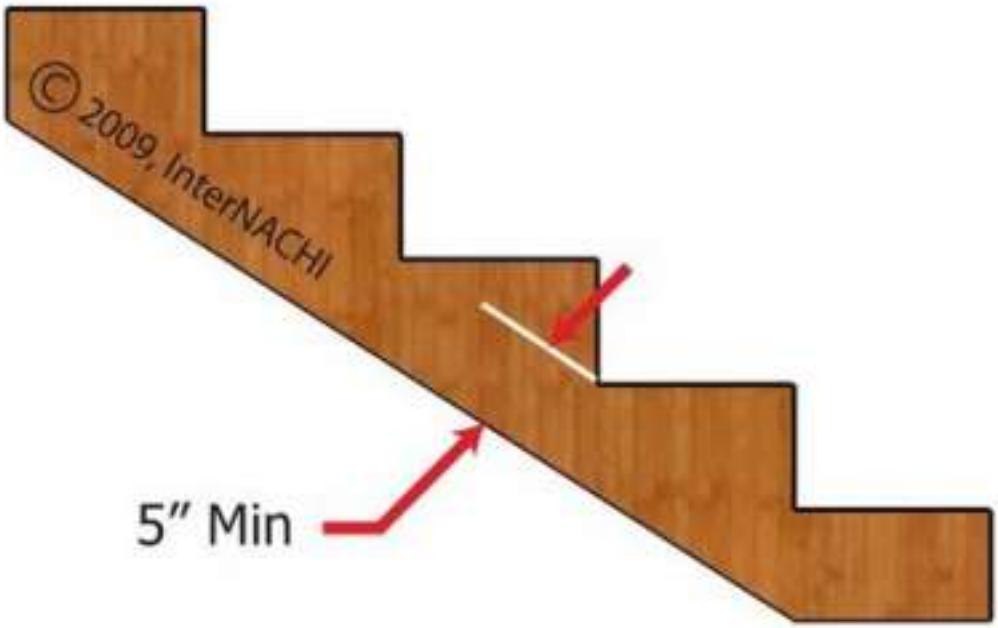
Most residential codes require the top of the guardrail to be at least 36 inches from the deck surface.

Infill spacing should not permit a 4-inch sphere to pass through.

Ladder-type guardrail infill on high decks is prohibited by some local codes because it makes it easy for children to climb over.

STAIRS

Deck Stair Stringer



The image above depicts a deck stair stringer. Stair stringers shall be made of 2x12 lumber, at a minimum, and no less than 5 inches wide at any point.

Stair Stinger Span

Stringers should be no more than 36 inches apart.

Stair Ledger Strips

Where solid stringers are used, stair treads should be supported with ledger strips, mortised, or supported with metal brackets.

Open Stair Risers

Most deck stairs have open risers and are not safe for children. Risers may be open but should not allow the passage of a 4-inch-diameter sphere.

Uniform Riser Height

To minimize tripping, the maximum variation among riser heights (the difference between the tallest and shortest risers) should be no more than 3/8-inch.

Deck Lighting

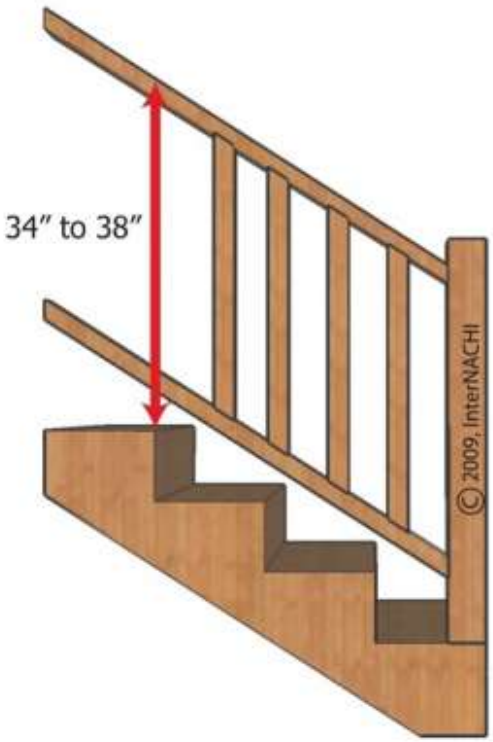
Decks rarely have light sources that cover the entire stairway. Any unlit stairway is a safety issue.

Stair Handrails

Stairs with four or more risers should have a handrail on at least one side.

Handrail Height

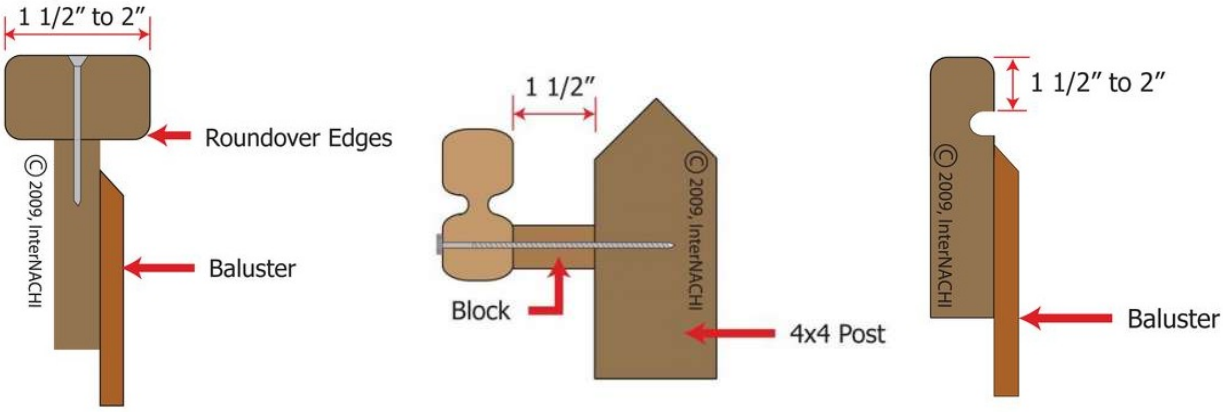
The image above depicts proper stair handrail height. Handrail height should be between 34 and 38 inches measured vertically from the sloped plane adjoining the tread nosing.



The image right depicts a stair handrail that is not graspable. Many deck handrails improperly consist of 2x6 lumber or decking. Handrails should be graspable, continuous and smooth.

The next three images depict graspable handrails.

Graspable Handrail

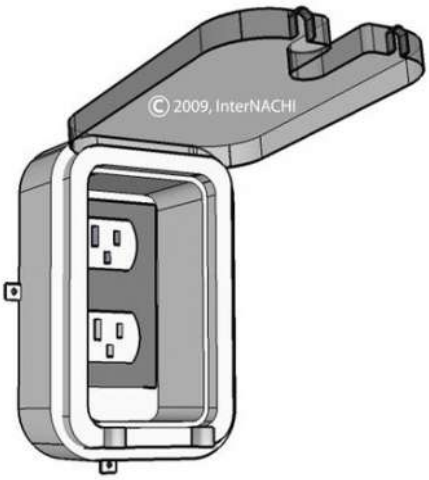


The three images directly above depict graspable handrails. Many deck handrails improperly consist of 2x6 lumber or decking. Handrails should be graspable, continuous and smooth.

Stair handrails should have posts at least every 5 feet.

The image left depicts permitted spacing at stairs. Larger spacing presents a child-safety issue.

Electrical Receptacles



As of 2008, the National Electric Code (NEC) requires at least one receptacle outlet on decks that are 20 square feet or larger.

The image above depicts a weatherproof receptacle cover. The deck receptacle should have a weatherproof cover.

Deck Location

Decks should not be located where they might obstruct septic tank accesses, underground fuel storage tanks, well heads, or buried power lines.

Quiz 16

More than _____ decks are built and replaced each year in North America.

- 2 million
- 10 million
- 100 million
- 5 billion

T/F: Posts in contact with soil should be pressure-treated.

- True
- False

In all but the lowest of decks, deck posts should be at least _____.

- 6x6 inches
- 4x4 inches
- 2x4 inches
- 8x6 inches

T/F: The most common causes of deck collapse are ledgers that pull away from the band joists of homes and buildings.

- True
- False

InterNACHI's ledger-fastener spacing formula provides inspectors with this rule of thumb: On-center spacing of ledger fasteners in inches = 100 ÷ joist length in _____.

- feet
- inches

All through-bolts should have _____ at the bolt head and nut.

- washers
- tapered ends
- sealant

T/F: Joists should be cantilevered no more than one-quarter of the joist length, or three times the joist width (nominal depth) -- whichever is smaller.

- True
- False

Decks greater than ____ feet above grade should have diagonal bracing from posts to girder, and from posts to joists.

- 6
- 12
- 3
- 8

Because of leverage, a 200-pound force pushing the deck's guardrail outward causes a _____-pound force at the upper bolt attaching the post.

- 1,700
- 250
- 15,000

Each segment of decking should bear on a minimum of _____ joists.

- four
- three
- two
- six

T/F: The deck's electrical receptacle should have a weather-proof cover.

- True
- False

Section 31: Inspecting a Garage

Inspecting a Garage

This section deals with the details of a garage and carport that may be included as part of the inspection of the exterior.

At the end of this section, you should be able to:

- describe the function of a firewall of a garage; and
- list some common concerns related to a garage.

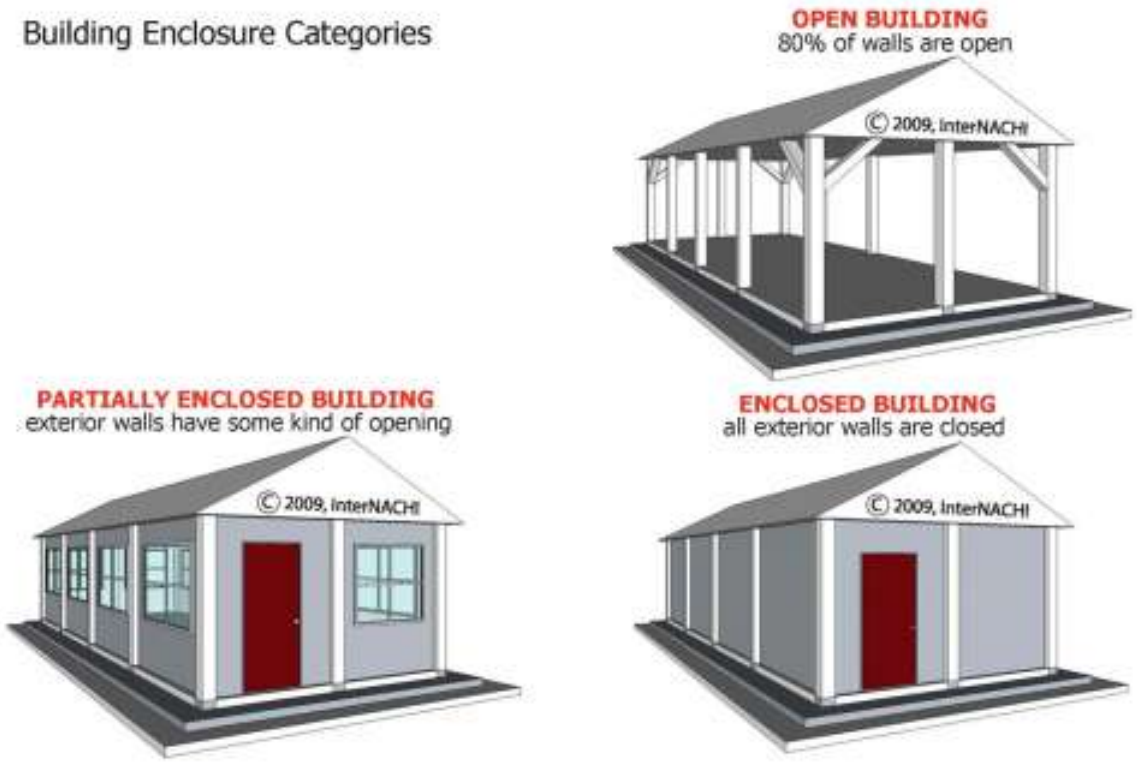
A typical garage is an enclosed, four-walled structure. Garages can be attached or detached from the house. One side of a garage has a door to accommodate an automobile. There is typically an egress door on the side of the garage. The floor of the garage is commonly concrete. Some detached garages have gravel, wooden or dirt floors. Other types of structures and carports can be categorized as being open, enclosed or partially enclosed.

Carports

A typical carport is an open building with posts. A carport does not have a door for an automobile. The carport floor is usually of the same material as the driveway. The carport structure may be freestanding or attached to the house structure at the wall or the roof.

The garage and carport structures are often included during the inspection of the exterior. While outside, you could easily inspect the carport. Detached garages take longer to inspect than attached garages because there are more structural issues to be concerned with. Attached garages are often simply inside the house's main structural design. An attached garage shares many systems and components with the rest of the house, including the foundation. Detached garages have their own

separate footings, structural components, roof system, siding, electrical system and components, doors and windows, interior components, etc.



Inspecting a garage is similar to inspecting a house. A detached garage and a house have the same types of items to inspect, including the systems and components related to the exterior.

A garage inspection may include the following:

- roof system;
- gutters and downspouts;
- exterior grading;
- siding;
- windows and doors;

- electrical system;
- foundation and structure;
- garage floor;
- interior;
- HVAC; and
- plumbing.

There are certain concerns that are particular to a garage. Some of them are related to fire and safety issues. You should know about the following issues when inspecting a garage:

- firewalls;
- openings;
- fire doors;
- the attic access;
- the garage door; and
- combustion appliances.

Firewall for Attached Garages

Aside from the information about firewalls in this section, you should understand that you should know and always refer to your local building codes. Your local building requirements may exceed the 2006 International Building Code (IRC) that is referred to in this section.

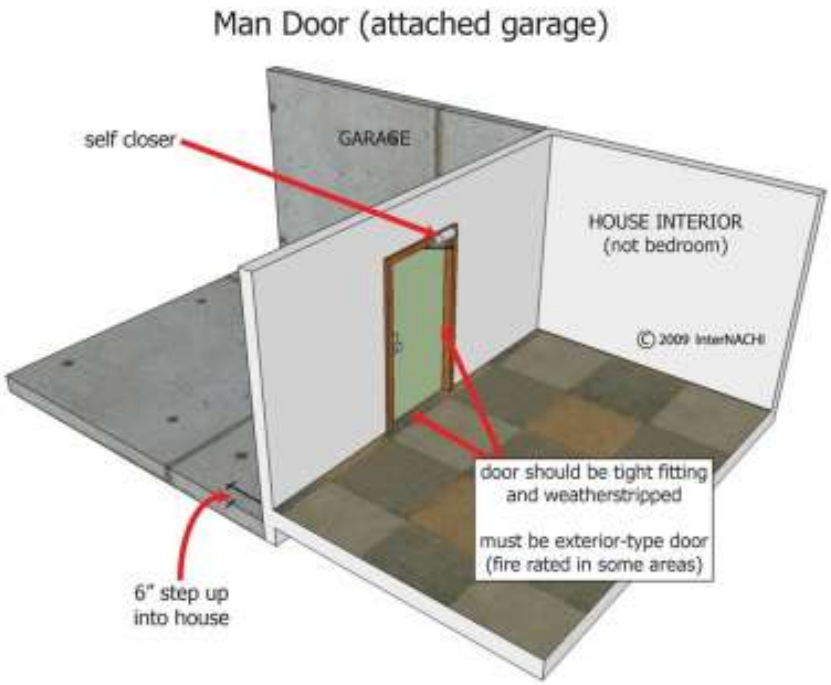
Garage firewall materials installed on the walls and ceiling of the garage must meet certain requirements, which are designed to protect the structure and its occupants. The requirements slow the spread of fire and keep hazardous gases controlled.

The fire-resistance rating at a garage wall, ceiling or door refers to the period of time the surface (gypsum, drywall, plaster) will serve as a barrier to the spread of fire. It indicates how long it can hold back a fire before it spreads to adjacent or attached areas of the house. Ratings of fire resistance are expressed in hours. Terms such as half-hour fire rating, one-hour fire rating, and two-hour fire rating are commonly used.

It is very important to check with the local authority having jurisdiction (AHJ) for clarification on the matters of fire-resistance requirements before you report any violations or defects. When in doubt, check with your local building official.

Opening Protection

Openings from a garage directly into a room used for sleeping are not permitted. Look for those openings. Look for any type of louvered air register in the



attached garage. This may be an open pathway to the house's interior.

Although the drywall or other approved material provides an adequate fire separation at the walls and ceilings between the house and the garage, it is important that all other openings in the firewall be appropriately protected. The type of door construction or fire rating of the door is a strict requirement.

The door between an attached garage and a dwelling unit should be a solid wood door not less than 1-3/8 inches thick, or a solid or honeycomb-core steel door not less than 1-3/8 inches thick, or a 20-minute fire-rated door. Interior doors, such as the ones you may find at a bedroom, are allowed, but not as the door which separates the garage and the adjacent room.

The code covers only the door itself and not the door assembly. The door assembly does not have to meet a fire rating. The type of door construction or fire rating of the door is important.

Self-Closing Door

Doors should have proper weatherstripping to create an airtight barrier between the garage and the living quarters. In many jurisdictions, a self-closing device on the door may be required. One more feature that helps to preserve the garage firewall is a self-closing door.

You may recommend a self-closing mechanism to your clients purchasing older homes. It is around $30, and all that is needed is to replace a couple of standard door hinges with spring-type, and adjust the door so it will close fully and completely by itself. In many jurisdictions, a self-closing garage door is required on new construction.

Ducts

Where any ducts pass through the drywall surface of the garage-side of the firewall, the duct material must be a minimum of No. 26 gauge (0.019-inch) galvanized steel. There should be no plastic or aluminum pipes or hoses (thin-wall or flexible) penetrating the walls or ceiling. If there is no other way to run those pipes, they should be insulated, boxed out, and finished with Type X 5/8-inch drywall, taped and compounded.

There must not be any openings in the ductwork within the garage area.

Drywall at Ceilings and Walls

It is common for a fire to start in an attached garage. The fire may grow unnoticed by the occupants and become a significant hazard. Therefore, a minimum amount of fire protection is needed.

There should be at least 1/2-inch drywall (gypsum board) applied on the garage-side to separate the garage from the residence and its attic space. Garages located below a habitable room shall be separated by at least 5/8-inch Type X drywall (gypsum board) or equivalent.

This standard requires a minimum level of fire protection from the garage to the dwelling unit. It allows the occupants time to escape. The separation also restricts the spread of fire from the garage to the dwelling unit until the fire can be controlled and extinguished.

All drywall seams at the ceiling and wall must be taped or finished with joint compound. Some jurisdictions may require fire-rated joint tape for this purpose. The garage firewall should have no missing or damaged drywall. All penetrations must be sealed. A fire-rated caulk can be applied at small gaps around the pipes, air ducts, door frames, etc.

Curb

Many building codes require a step or a curb between the house door and the garage floor. That places the floor of the house slightly above or elevated higher than the garage floor surface. The step may be a minimum of 4 inches. This curb could prevent spilled gasoline vapors from drifting into the house.

Electrical Box in the Firewall Ceiling

An opening in the firewall may not be obvious. Take, for example, an electrical outlet box in the ceiling of a garage, with a habitable space above the garage.

There are outlet and device boxes available that are listed for use in fire-resistance-rated partitions without the use of putty pads, mineral wool or fiberglass. There are non-metallic outlet boxes that can be installed in a garage firewall that meet the fire-resistance standard. As an inspector, you will not be able to determine visually if the box is fire-rated. They will be listed and identified by the manufacturer, but this identification goes well beyond the Standards of Practice. In an older home, the box will likely not be fire-rated.

A box in the garage ceiling or wall must not be installed back-to-back with another box.

For both metallic and non-metallic electrical outlet boxes, the maximum gap around the box is 1/8-inch for a firewall.

Putty pads are moldable pads that can be used to wrap metal electrical boxes, or inserted on the inside back wall of metal electrical boxes. When exposed to fire, the pad expands and seals off any openings. An 1/8-inch thick pad provides a one-hour fire-resistance rating.

Receptacles

Since the early 1970s, GCFIs have been required in an increasing number of wet or damp locations, and, more recently, this requirement has extended to all receptacles

in garages. Because they are safety devices, the home inspector should check every installed GFCI circuit, and may advise the client of areas where they should also be fitted.

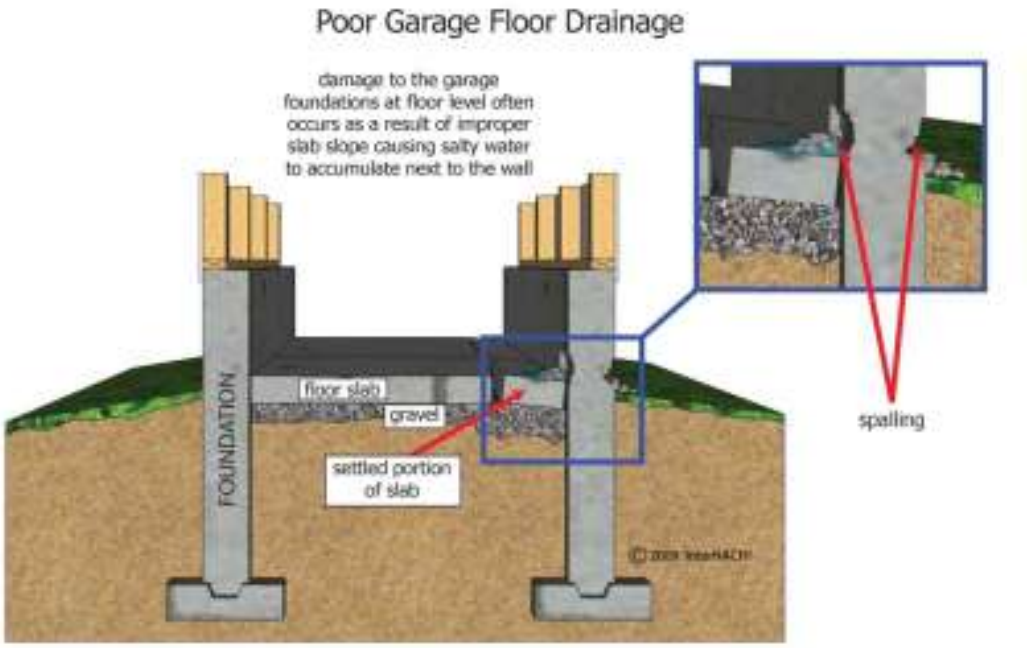
Garage Floor

The garage floor should be a non-combustible material and sloped toward the floor drain (if one is installed) or toward the vehicle door opening. The slope of the garage surface allows for water on the garage floor to drain away.

Garage floors that are structural or suspended floors should be inspected by a specialist. Loads on a structural floor are considerable, and distress on the floor structure may not be readily apparent to a home inspector during a home inspection. You cannot simply get a sense of whether a garage floor is structurally strong enough to support the weight of a car. If you see any cracks or deterioration in the structural or suspended floor, you should recommend further evaluation by an expert or specialist.

Poor Drainage at the Garage Floor

You should look at the garage floor to see that it is relatively uniform and is sloped properly toward the vehicle door opening.



If there are structural problems with the concrete floor in the garage, there may be cracking at the corners or along the walls of the garage. Sometimes, you may find large sections of the garage floor that have cracked and settled. Sometimes, you may see that the entire garage floor has settled, but uniformly. That's okay if there is still proper slope toward the vehicle door opening. If there is a floor drain, the floor needs to slope toward that drain properly.

Attic Access

An attic access installed in the garage is an important part of a firewall. An open access to the attic space above the garage may create a vacuum, and a garage fire may be sucked into that attic. The garage attic access should be closed at all times.

One-story and ranch-style homes with an attached garage typically have no ceiling in the garage and an open attic above the house. In such situations, the garage firewall or house separation wall should extend all of the way to the roof, or a garage firewall ceiling should be installed.

You may find a garage attic access that may not be equivalent to the firewall. A common garage attic access is a square piece of plywood or drywall, usually resting on four pieces of wood trim. Drywall may be approved by the local AHJ, but the trim neither provides a proper seal nor has a required fire rating. Be careful here. Make sure you know what the local building requirements and standards are in your area.

Attic pull-down stairs finished with a 1/4-inch-thick plywood paneling may be considered by the local AHJ as a violation of the firewall or separation between the attic and garage. The pull-down stairway assembly rarely provides a proper seal along the opening. Have your local code-enforcement inspector or officer comment on it.

Separation

In order to protect a house from a garage fire that is in a detached garage, a minimum degree of spatial separation is required. Where a separation of a least 3 feet is not provided, a minimum of one layer of ½-inch gypsum board or drywall should be installed on the interior-side of the garage.

Mechanical Systems

Gasoline leakage or spillage in a garage can sometimes happen. This could be a hazardous situation. Gasoline vapors will evaporate from liquid puddles at the floor level. Any potential ignition source should be elevated to keep open flame, spark-producing elements and heating elements above the gasoline's vapor level.

An appliance with an open flame, spark-producing element or heating element should be elevated such that the source of ignition is at least 18 inches above the garage floor.

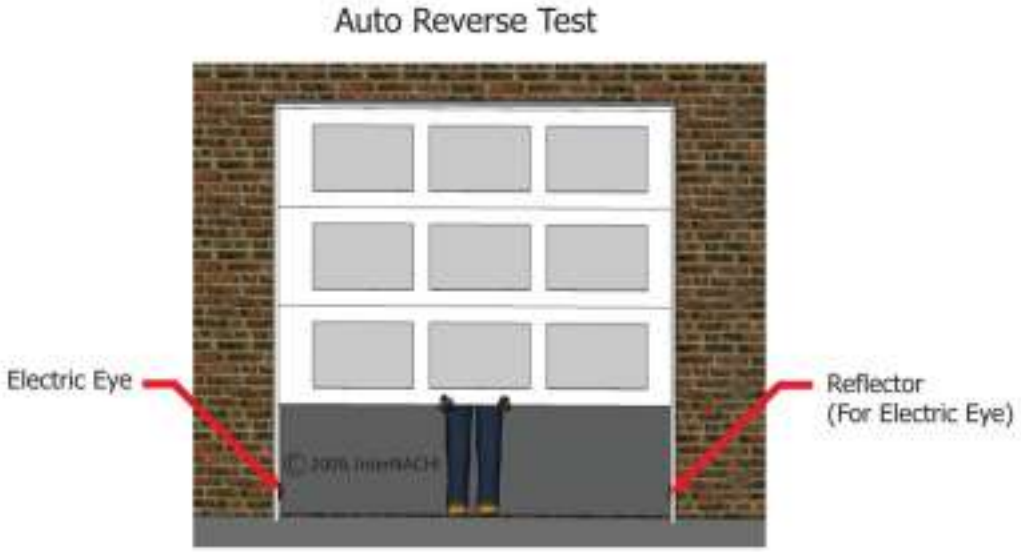
Impact

Appliances and equipment located in a garage or carport should be protected from impact by an automobile. Appliances and equipment exposed to impact by vehicles could create a hazardous situation if their fuel connections are broken, loosened or damaged. The appliances and equipment should be protected by a barrier, such as a curb wheel stop or pipe stanchions.

Section 32: Garage Door-Opener Inspection

Garage Door-Opener Inspection

The garage door is the largest moving object in a house. Its parts are under high tension. All repairs and adjustments should be performed by a trained garage door systems technician. To find a technician, refer your clients to the International Door Association. If the garage door appears inoperable, do not attempt to operate the



garage door opener.

Manual-Release Handle

Begin inside the garage, with the garage door fully closed. Check for a manual-release handle or the means of manually detaching the door from the garage door opener. The handle should be colored red and easy to see. The handle should be accessible and no more than 6 feet above the garage floor.

Garage Door Panels

From inside the garage with the door fully closed, check the condition of the door panels. There shouldn't be any cracks, loose pieces, separations or damage.

Warning Labels

From inside the garage with the door fully closed, look for the following warning labels:

1) a spring warning label attached to the spring assembly;

2) a general warning label attached to the back of a door panel;

3) a warning label attached to the wall in the vicinity of the wall control button; and

4) two warning labels attached to the door in the vicinity of the bottom corner brackets.

NOTE: Some newer doors have tamper-resistant bottom corner brackets that will not require these warning labels.

Springs and Hardware

With the door still in the closed position, look at the springs for damage. Don't operate the door if a spring is broken. Operating the door with a damaged component can cause serious injury or death. Recommend that the door not

be used until the damaged spring is replaced by a trained door systems technician. Visually check the door's hinges, brackets and fasteners. If the door has an opener, the door must have an opener reinforcement bracket that is securely attached to the door's top section. The header bracket of the opener rail must be securely attached to the wall or header using lag bolts or concrete anchors.

Door Operation

Close the door fully. If the door has an opener, pull the manual release to disconnect the door from the opener. Without straining yourself, manually lift and operate the door by grasping the door in a safe place where your fingers cannot be pinched or injured. If the door is hard to lift, then it is out of balance. This is a hazardous condition, and correction by a technician should be recommended.

Raise the door to the fully-open position. Then close the door. The door should move freely and without difficulty, but it should not open or close more quickly than the force applied. If the door is difficult to open or close, the door should be inspected by a trained door systems technician.

The rollers should stay in the track. If any rollers fall out of the track, the door system should be repaired by a trained door systems technician.

After conducting this check, reconnect the door to the opener, if present. This is generally done by activating the opener until it reconnects itself to the door.

Spring Containment

The counter-balance system is usually comprised of torsion springs mounted above the door header, or extension springs, which are usually found next to the horizontal track. When springs break, containment helps to prevent broken parts from flying dangerously in the garage. Torsion springs are already mounted on a shaft, which inherently provides containment. If the door has extension springs, verify that spring containment is present. Extension springs should be contained by a secure cable that runs through the center of the springs.

Wall Push Button

Locate the push button on the wall. Measure the vertical distance between the button and the floor. The button should be at least 5 feet above the standing surface and high enough to be out of reach of small children. Press the push button to see if it successfully operates the door.

Photo-Electric Eyes

Federal law states that residential garage door openers manufactured after 1992

must be equipped with photo-electric eyes or some other safety-reverse feature. If the garage door has an opener, check to see if photo-electric eyes are installed. They should be near the floor, mounted to the left and right sides of the bottom door panel. The beam of the photo-electric eyes should not be higher than 6 inches above the floor.

Non-Contact Reversal Test

This check applies to door systems that are equipped with photo-electric eyes. Standing inside the garage and safely away from the path of the door, use the remote control or wall button to close the door. As the door is closing, wave an object in the path of the photo-electric eye beam. The door should immediately reverse and return to the fully-open position.

Contact Reversal Test

In rare instances, a contact reversal test could damage the door system when the opener's force setting has been improperly set, or when the opener reinforcement bracket is not securely or appropriately attached to the top section. If you are concerned that a contact reversal test may cause damage, don't conduct the test. This check applies to doors with openers.

Begin this test with the door fully open. Under the center of the door, place a 2x4 piece of wood flat on the floor in the path of the door. Standing inside the garage, but safely away from the path of the door, use the wall push button to close the door. When the door contacts the wood, the door should automatically reverse direction and return to the fully-open position.

Quiz 17

T/F: Openings from a garage directly into a room used for sleeping purposes are not permitted.

- True
- False

T/F: In many jurisdictions, a self-closing device on the door that separates an attached garage from the habitable area may be required.

- True
- False

T/F: The garage door is the largest moving object in a house.

- True
- False

Federal law in the U.S. requires that residential garage door openers manufactured after ____ must be equipped with photo-electric eyes or some other auto-reverse safety feature.

- 1992
- 1972
- 2001
- 1980

Section 33: Other Exterior Systems

Other Exterior Systems

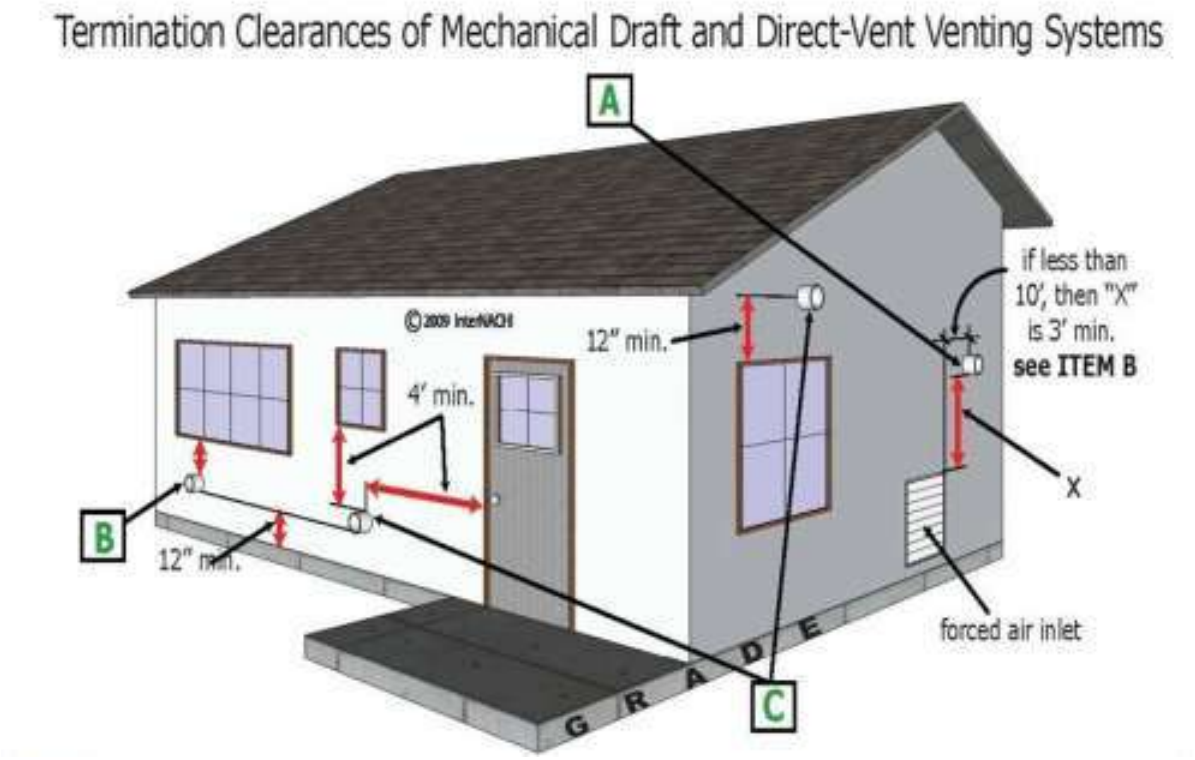
While inspecting the outside of the house, you will see components of other systems. Most inspectors will inspect these other parts of systems while they are conducting the inspection of the exterior instead of waiting later. For example, while you are inspecting the exterior, you may also inspect the air-conditioner unit outside, which is part of the inspection of the HVAC system.

Examples of components of systems (other than the exterior) that you may inspect while conducting the inspection of the exterior may include, but are not limited to:

- exterior hose bibbs;
- main water service meter and shut-off valve;
- lawn sprinkler system;
- sewer vent pipes;
- septic system components;
- sump pump discharge;
- electrical service lines, service entrance, conductors, meters and disconnect;
- electrical service to detached outbuildings or detached garages;
- exterior lights and receptacles;
- fresh-air vents for fireplace chimneys;
- exhausts from heating systems or ventilation systems;
- oil fill and vent pipes from an oil storage tank;
- overflow drainpipes;
- exterior condenser units for an air-conditioning unit or heat pump system;
- refrigerant line;
- condensate discharge;
- evaporative swamp cooler;
- ventilation for roof system, including the soffit and gable;
- crawlspace access and ventilation;

- exhaust vents from the kitchen and bathroom;
- exhaust vent from the clothes dryer;
- cracks at the structure and foundation;
- indications of settlement and movement of the structure and foundation; and
- movement of walls.

You may inspect these things (and more) while you are outside, collect the information, and combine that information with that of your inspection of the other systems that you encounter at a later time.



ITEM A: *A mechanical draft-venting system shall terminate at least 3 feet above any forced-air inlet located within 10 feet.*

ITEM B: *The vent terminal of a direct-vent appliance with an input of 10,000 BTUs per hour or less must be located at least 6 inches from any air opening into a building. If the input is over 10,000 BTUs per hour but not over 50,000 BTUs per hour, the vent termination must be located at least 9 inches from any air opening. If the input is over 50,000 BTUs per hour, the vent termination must be located at least 9 inches from any air opening. The bottom of the vent terminal and air intake must be at least 12 inches above grade.*

ITEM C: *Vents, excluding direct-vent appliances, shall terminate at least 4 feet below, 4 feet horizontally from, or 1 foot above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches above grade.*

Section 34: Chimneys

Chimneys

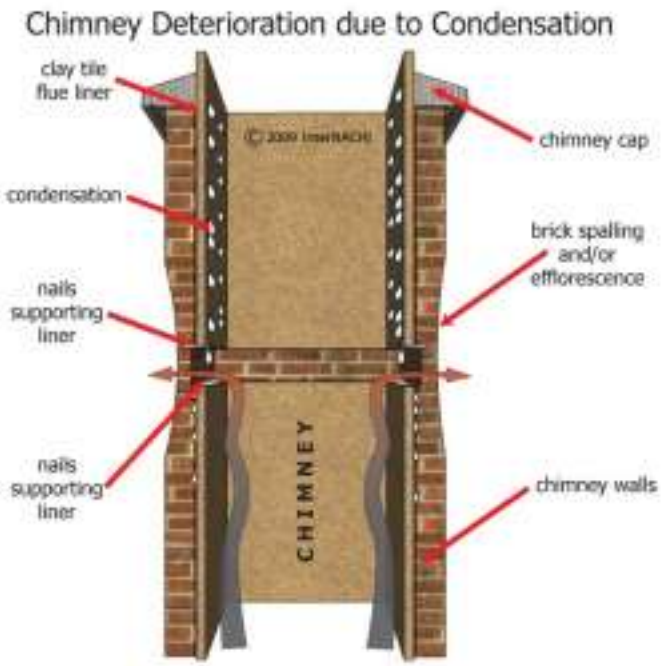
If there is a chimney at the property, look at it while performing the exterior inspection. Chimneys have greater exposure to the weather than most building components, and they have no lateral support from the point where they emerge from the roof. Problems can develop at any point in time as the house ages. A chimney sweep can monitor the chimney structure for your client.

Chimney Cap

You'll often find that the inspection of various systems overlaps. You may inspect the chimney stack during the inspection of the roof system. You may decide to check the top of the stack during the time that you inspect the roof surface.

The top of the chimney stack can deteriorate due to a deteriorated cap that allows water into the masonry below and exposes it to freeze-thaw cycles. This cap is typically made of a tapered layer of mortar, called a cement wash, which cracks and breaks after several years. If the cap is mortar and the chimney has a hood, the mortar will need to be repaired. If the cap is mortar and the chimney does not have a hood, the mortar should be replaced with a stone or concrete cap. If the cap is stone or concrete, it will need to be repaired or replaced.

Settlement or Leaning



An inadequate foundation can cause differential settlement of the chimney, but the foundation is underground and not readily visible. If the chimney is part of an exterior wall, it will tend to lean away from the wall and crack where it is joined to other masonry. In some cases, the chimney can be tied to the building.

The chimney could lean where it projects above the roof due to deteriorated mortar joints caused either by wind-induced swaying of the chimney, or by sulfate attack from flue gases and particulates within the chimney when the chimney is not protected by a tight flue liner.

You could recommend that deteriorated mortar joints be re-pointed, and unstable chimneys and those with a noticeable lean be further evaluated by a chimney expert for repairs, which may include dismantling and rebuilding.

Cleanout Door

The cleanout door of the chimney flue may be found outside. Oftentimes, the cleanout door will be found at the base of the chimney flue on the exterior-side of the stack. The door may be metal, steel or cast iron. Check this cleanout door for proper operation. It should not be missing, damaged or corroded.

Section 35: Defensible Space

Defensible Space

Defensible space refers to the area surrounding a building that is mitigated to protect it from wildfires. Along with the quality of a building's roofing material, adequate defensible space is one of the most important factors in determining a building's ability to survive a wildfire. Inspectors should know enough about defensible space to educate their clients, particularly in fire-prone regions.

Defensible space performs the following functions:

1. Ideally, a carefully maintained defensible space does not contain enough fuel to allow a wildfire to reach a house. Even if the space is breached, the fire will be slowed and weakened, helping firefighters to defend the house.
2. A defensible space provides an accessible area for fire trucks to park and firefighters to work during a structure fire.
3. If there is a pond near a burning house, it can be used to replenish a fire truck's water supply. The perimeter of the pond should be thinned of trees and brush sufficiently so that firefighters can access it.

The size requirements for defensible space vary by jurisdiction because the potential for wildfires varies by region. Buildings in forested areas of the Southwest need a much larger protective space than in New Jersey, for instance. As of 2006, California state law mandates a minimum of 100 feet of defensible space for houses in rural locations. Trees and shrubs surrounding a house should be trimmed and spaced apart a safe distance from one another. Chainsaws can be used to remove trees and branches, pruning shears can be used to trim plants, and rakes can be used to remove pine needles and other ground-level combustibles. Trees that are very close to the house should be removed because this is where fire prevention is most critical. Vegetation can be plentiful toward the perimeter of the space if it is green and pruned.

Colorado State University divides defensible space into three categories in the following manner:

- Zone 1 is the first 15 feet from a home and should be devoid of all flammable vegetation. Firewood and other flammable materials should not be stored in this area.
- Zone 2 is the area of fuel reduction that extends from Zone 1 outward to between 75 to 125 feet from the structure. Trees and large shrubs should be no less than 10 feet apart, especially in steep terrain. Trees must also be pruned to a height of 10 feet from the ground, and any "ladder fuels" (vegetation with vertical continuity) should be removed from the base of the trees. Grass, trees and shrubs in this area should be green and adequately spaced. Pine needles, dead leaves, branches, dead and dying vegetation, and other flammable debris on the ground should be removed whenever they appear.

- Zone 3 is the area of traditional forest management and is of no particular size, although it normally extends to the property's limits. More trees are permitted here than in Zone 2, although their health and vigor should be maintained.

Precautions that Inspectors Can Pass on to Their Clients

- Homeowners should obey all environmental protection laws while creating and maintaining defensible spaces. In particular, removal of vegetation should not interfere with the well-being of endangered species, air and water quality, or archaeologically significant resources. Homeowners may need to obtain a permit to cut down trees over a certain size, depending on local jurisdictions.
- Vegetation removal can cause soil erosion, especially in steep terrain. In areas that are prone to wildfire and soil erosion, it can be helpful to replace highly flammable plants and trees with less-flammable alternatives.

In summary, buildings can be spared from wildfire damage through the removal of surrounding flammable vegetation. Defensible spaces are critical in hot, dry, forested regions, although their presence is recommended everywhere.

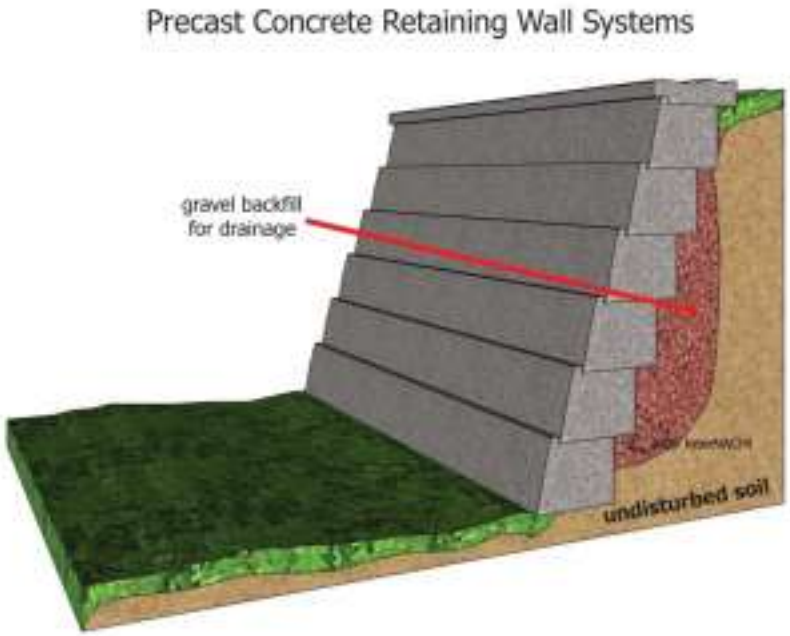
Section 36: Retaining Walls

Retaining Walls

This section deals with the details of retaining walls that may be observed during an inspection of the exterior.

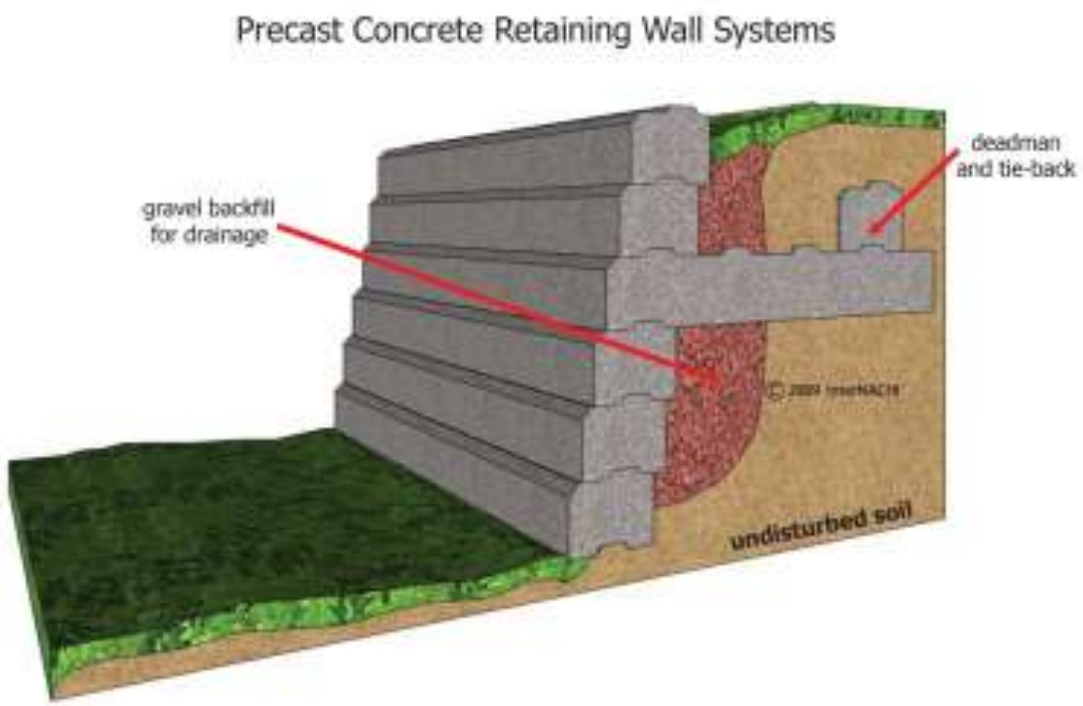
At the end of this section, you should be able to:

- list different types of retaining walls;
- describe the function of a retaining wall; and
- list some concerns related to retaining walls.



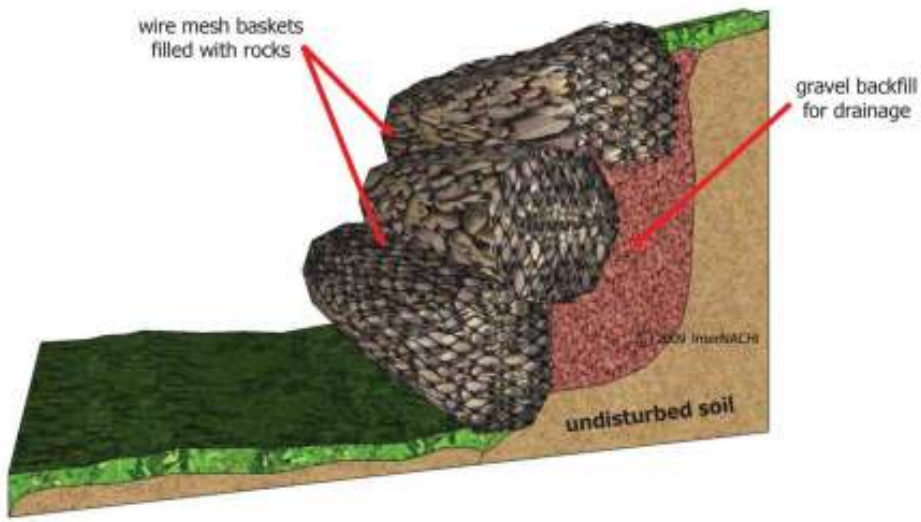
Retaining walls are a common feature at many residential properties. They can be made from a variety of materials, including stone, brick, concrete, block and wood. The most common problem with a retaining wall is poor drainage.

There are building standards and best practices that provide some criteria related to the required design features of a retaining wall. Where wood is installed in retaining walls, the wood should be pressure preservative-treated or of a wood species that has natural protective properties.



Retaining walls that are more than 24 inches tall and not laterally supported at the top should be designed to ensure stability against overturning, sliding, excessive foundation pressure, and water uplift.

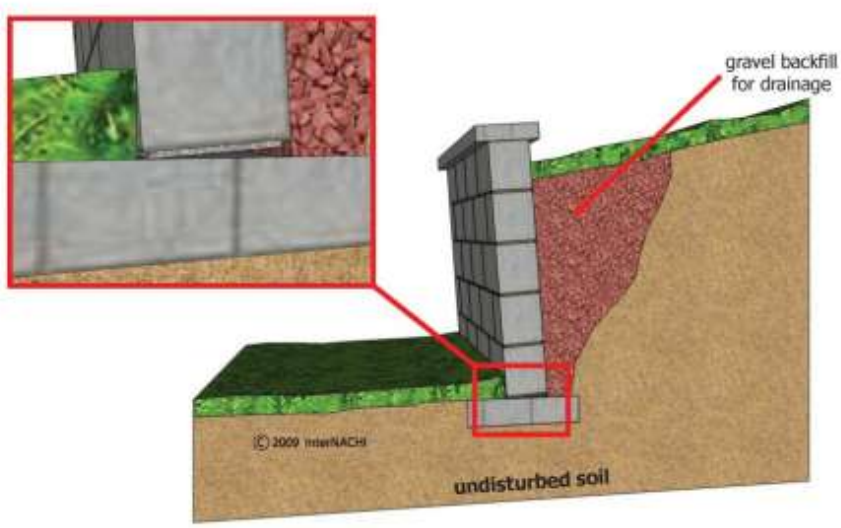
Gabion Retaining Walls



Look for Movement

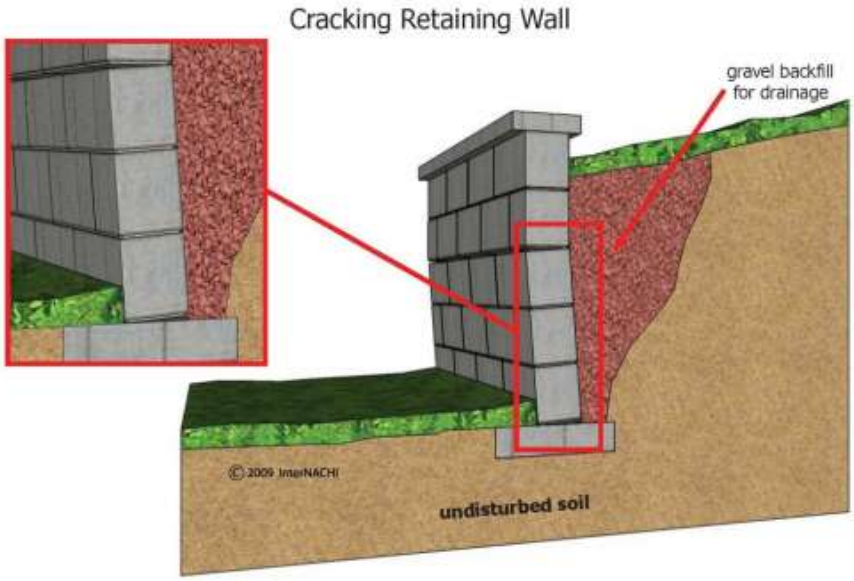
Bowing (vertical bulges), sweeping (horizontal bulges), and cracking in retaining walls can be caused by water or hydrostatic pressure. Bulging can also be a result of inadequate strength of the earth behind the wall to resist the load. Bowing and sweeping failures may be correctable if found early enough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

Leaning Retaining Wall

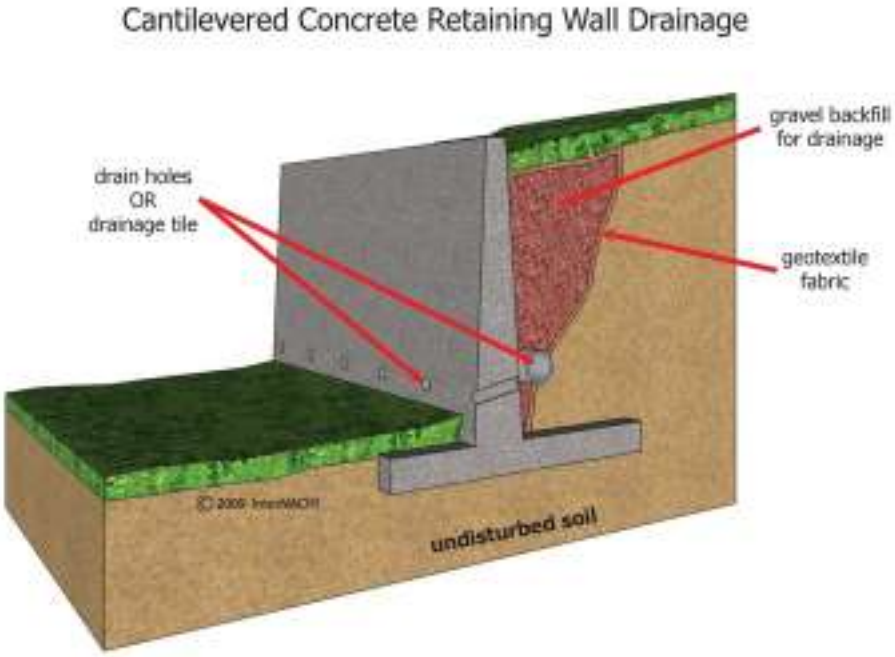


There are other types of failures of retaining walls. Failure by overturning (leaning from the top) or sliding may be caused by inadequate wall strength. In addition,

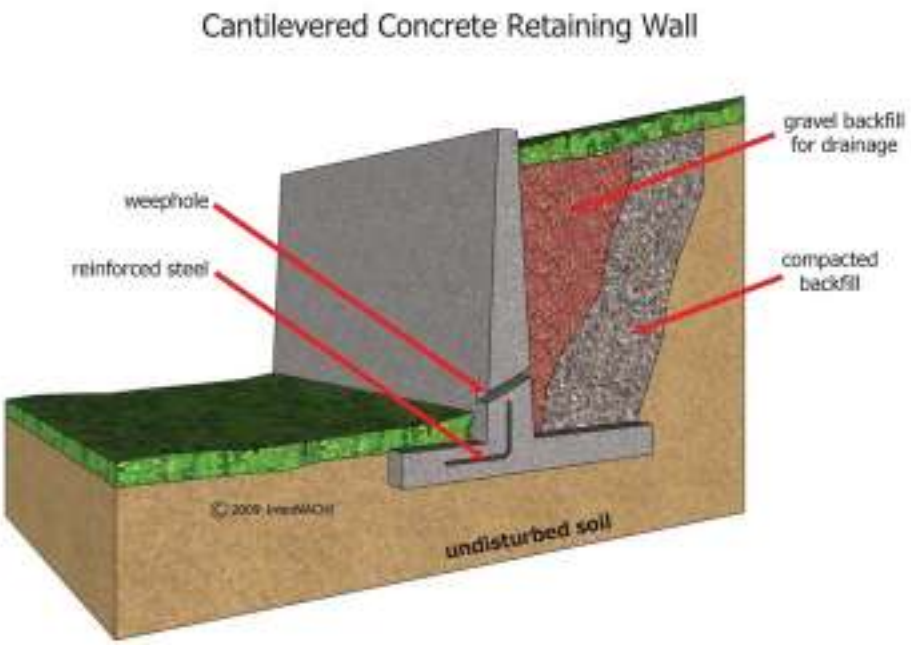
water behind a wall can create moist bearing, especially in clay soils, and contribute to sliding. Retaining walls also fail due to settlement and heaving.



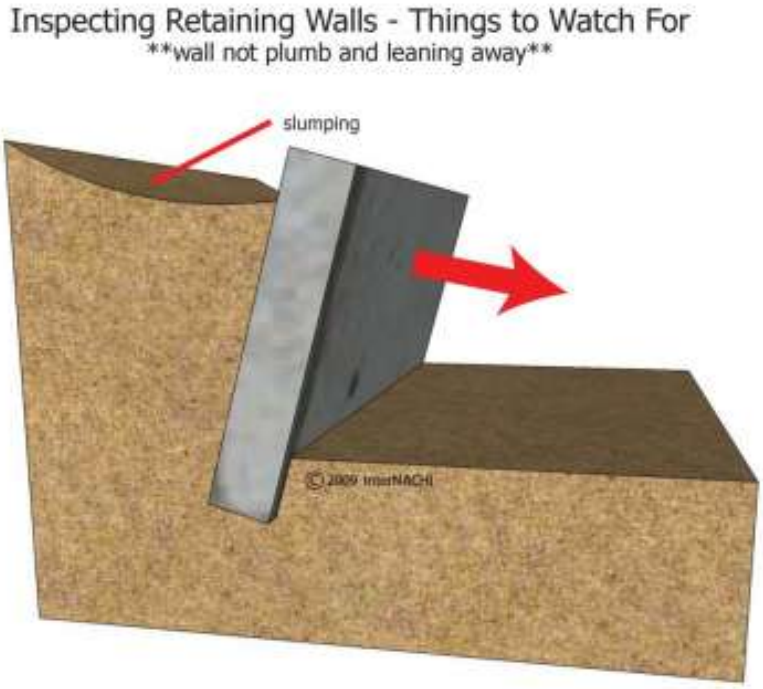
Settlement occurs whenever filled earth below the wall compacts soon after the wall is built, or when wet earth caused by poor drainage dries out and soil consolidates. Poor drainage contributes to failure in cold climates by creating heaving from frozen ground.



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 and masonry, and heaving may be controlled by proper drainage.

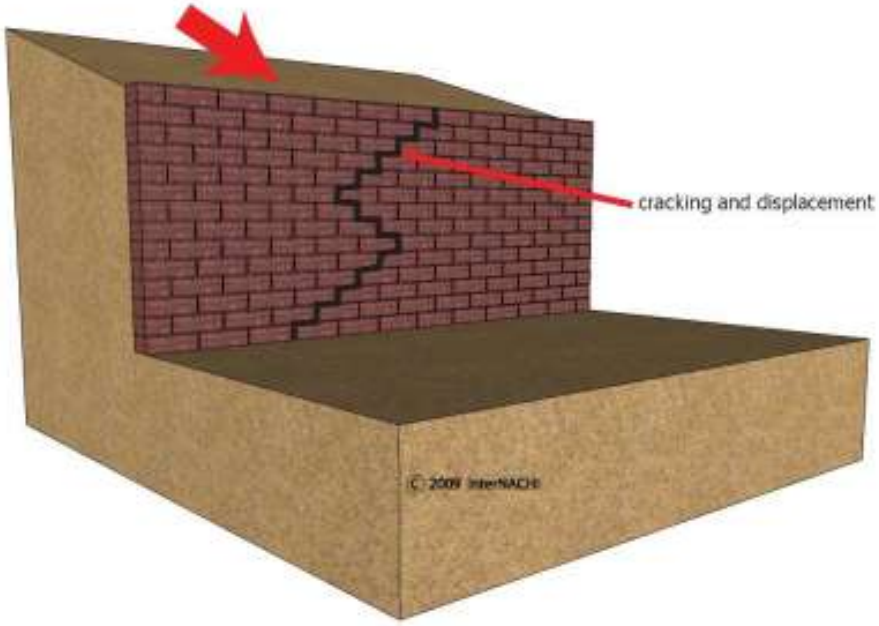


Significant failure of any kind usually requires rebuilding or replacing all or part of a wall. Recommend the consultation of a qualified professional when major repairs or corrections are needed.



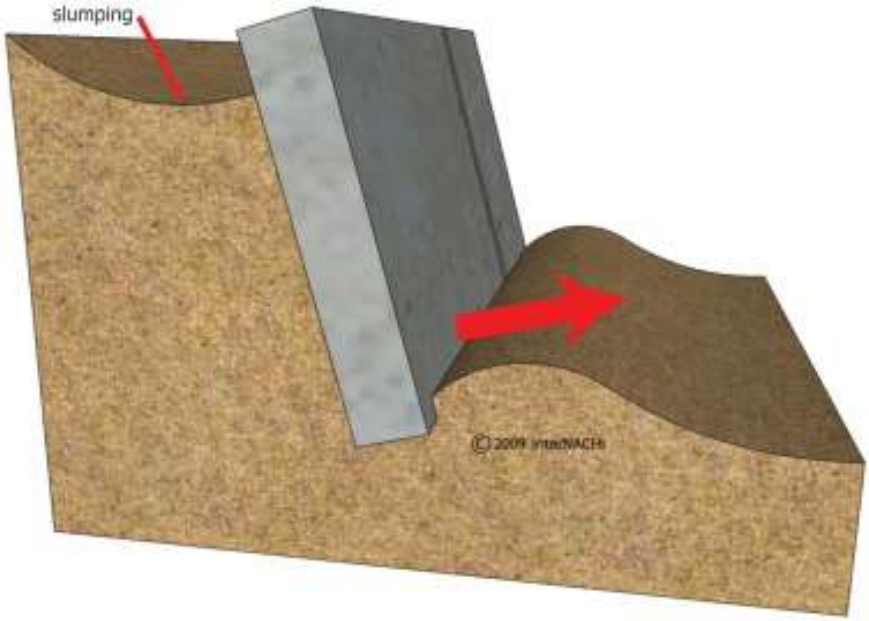
Inspecting Retaining Walls - Things to Watch For

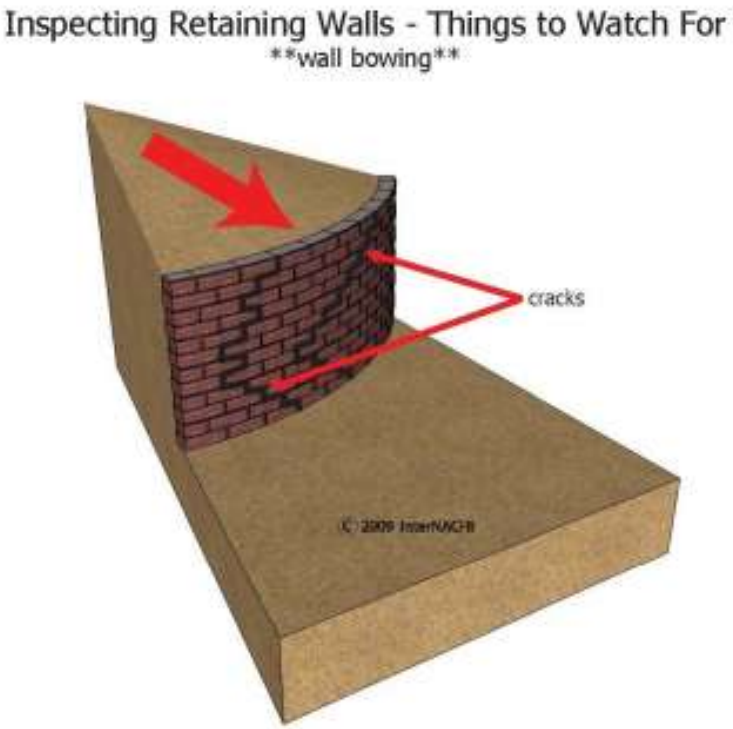
displacement of individual units



Inspecting Retaining Walls - Things to Watch For

bottom of the wall has slipped





Section 37: Driveways, Walkways and Pavement

Driveways, Walkways & Pavement

Cracks and Settlement

Check the paved areas. Asphalt and concrete are commonly used for driveways and walkways. You may encounter brick, gravel and packed soils.

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. Walkways and driveways may crack, crumble or settle over time. Safety

hazards may develop, and those hazards should be checked and noted in an inspection report.

Paved areas immediately adjacent to a building should slope away from the perimeter of the building (or foundation) walls. Paving that is not sloped to drain water away from a building should be repaired.

Look for any paving that has large cracks, broken sections, high areas, low areas that trap water, and tripping hazards. Repairing concrete often requires total replacement. Resurfacing with a thin layer of more concrete cannot repair concrete.

Concrete should be no less than 3 inches thick. Cracks in concrete can be cut open and sealed with a flexible sealant compound, which will extend its service life. For sidewalks that have settled downward, it may be possible to lift up sections.

Asphalt Surfaces

Sealing asphalt paving extends its life. Homeowners should seal-coat their asphalt driveways every three to five years. Examine the paving to determine when sealing is needed. Check asphalt driveways for sunken areas that hold water. Low areas in asphalt paving can be brought to level with an asphalt repair.

Paving

Paving does not last forever. Brick and stone patio paving could be set on a concrete slab, in a mortar bed with mortar joints, or in a sand bed that is laid on earth. Mortar joints can be tuck-pointed. Loose bricks and stones can be reset in a new mortar bed. Pavers set in sand can be taken up easily, sand can be added or removed, and the pavers replaced.

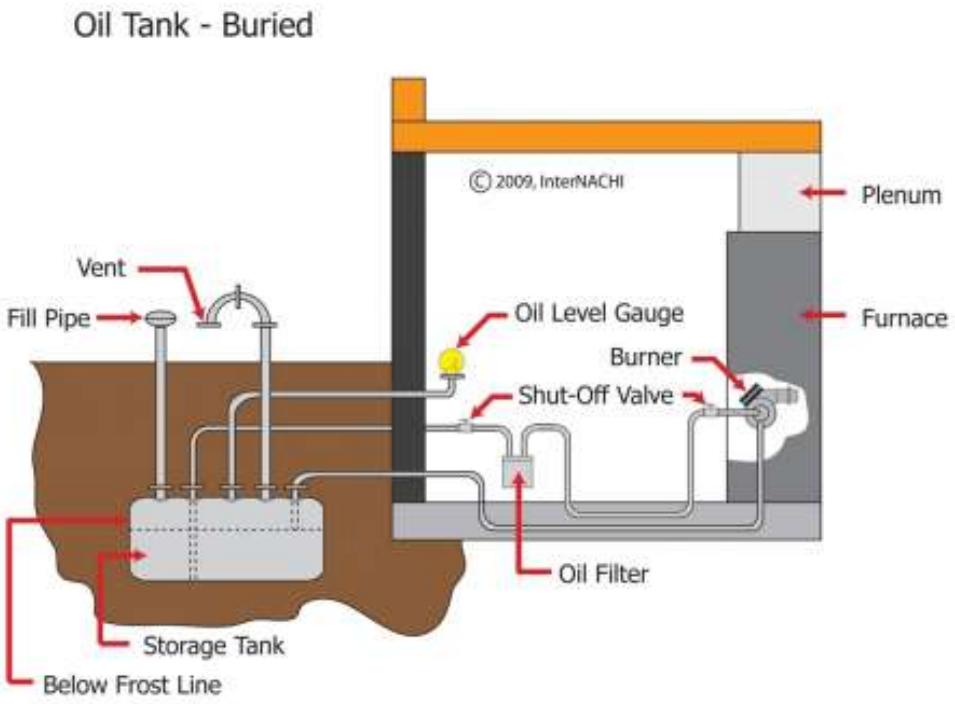
Responsibility

The maintenance and repair of sidewalks, drive aprons, and curbs at the street may be the property owner's responsibility or that of the local jurisdiction. Many inspectors check those areas for their clients and report the condition of those items that may be the clients' responsibility to maintain.

Section 38: Buried Oil Tanks

Buried Oil Tanks

A buried oil tank is beyond the scope of a home inspection. Inspectors who come across the indications of a buried oil tank could inform their client of their findings.



Buried ferrous-metal oil tanks are common on older properties whose home or domestic water is heated by oil. The evidence of a buried oil tank can be covered up by landscaping. The presence of a buried oil tank can usually be determined by finding the fill and vent pipes that extend above ground. Abandoned and very old buried ferrous-metal oil tanks are an environmental hazard.

If there is a buried tank on the property, the soil around it should be tested for the presence of oil seepage by a qualified environmental professional. 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.

As with all underground items, a buried oil tank is not within the scope of a visual home inspection.

Section 39: Other Exterior Considerations

39.1 Additional Exterior Structures

Additional structures, storage sheds, and other outbuildings should be kept in good condition in the same manner that the home is maintained. Your client should monitor each outbuilding's water-shedding capability, and the adequacy of its foundations. Advise your client to look for roof leaks from inside the buildings. Wood-frame structures should be checked for rot and insect infestation.

The doors and windows of outbuildings should be checked to assure that they provide adequate weather protection and security.

Small outbuildings should have sufficient structural strength to sustain wind loads or seismic forces, and this may be more than just a simple judgment call. If the site is in a hurricane or high-wind region, you might check all outbuildings for their ability to resist a storm without coming apart and becoming windborne debris. Consider recommending to your client a consultation with a qualified professional experienced in high-wind or seismic issues.

39.2 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 to the interior rooms of the home may be a function of the dimensions of the yard or court. Check these characteristics, as well as zoning, 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.

39.3 Flood Zones

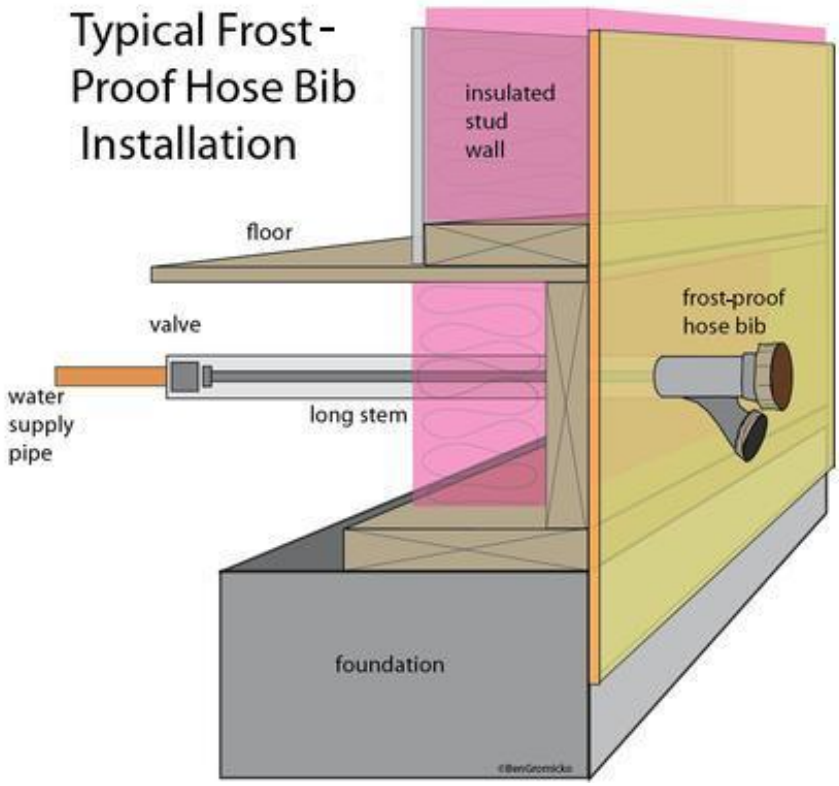
Check with local authorities to determine if your client's home is in a flood-risk zone. If it is, check with local building officials. Many communities have adopted higher standards than those set by national agencies.

The Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program have established and defined five major flood-risk zones and created special flood-resistance requirements for each. For a flood map, visit the FEMA Map Service Center. Improperly designed grading and drainage may aggravate flood hazards to buildings and cause runoff, soil erosion and

sedimentation. Local agencies may regulate building elevations that are above street or sewer level.

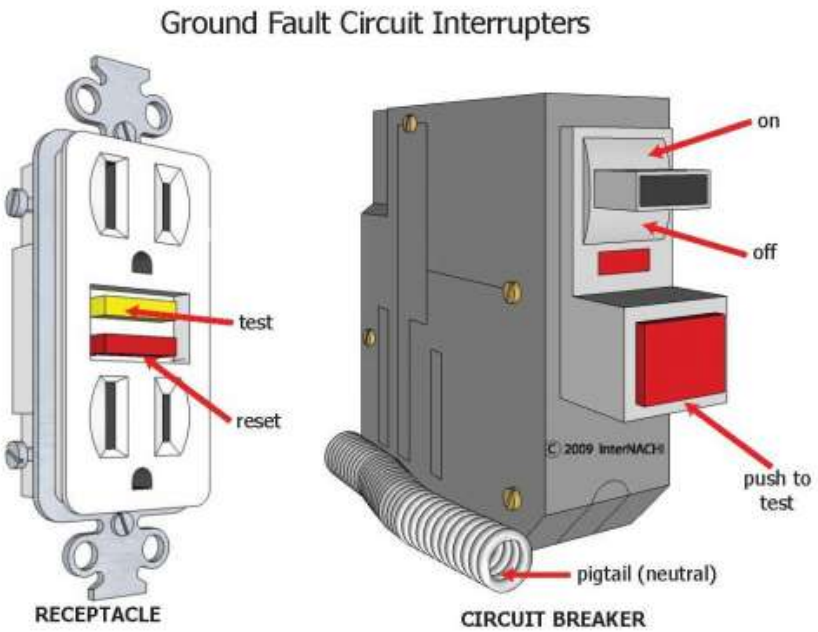
39.4 Exterior Water

Exterior hose spigots should be frost-proof. You can't see the frost-proof feature from outside. Unlike a traditional hose bibb whose valve stem is 1 or 2 inches in length, the valve stem for a frost-proof hose bibb (or sillcock) could be 6 to 30 inches long. Thus, the valve is well within the exterior wall and protected from cold and freezing.



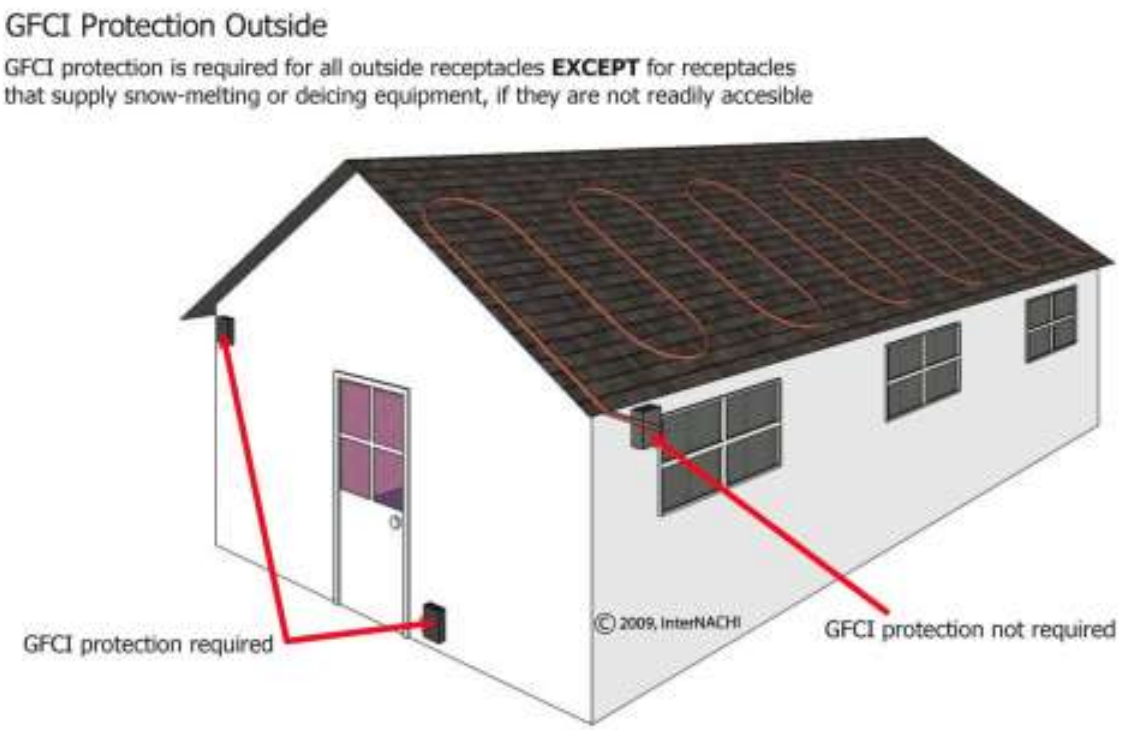
39.5 GFCI Protection for the Exterior

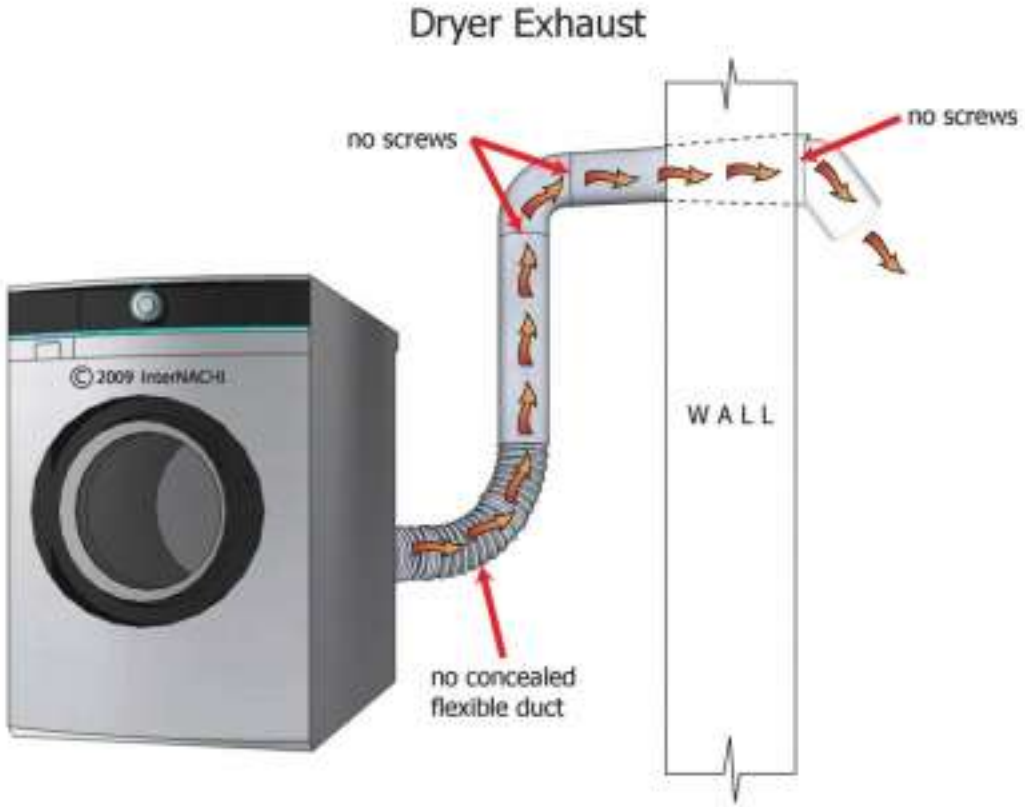
All exterior electrical receptacles should have GFCI protection.



39.6 Clothes Dryer Exhaust

The appropriate length of a clothes dryer exhaust ensures that the dryer exhaust blower will be able to push sufficient air volume to take away the damp air and lint. The length can be increased only when the make and model of the dryer are known, or when an approved blower-fan calculation is provided.





The maximum length of a clothes dryer exhaust duct should not be greater than 25 feet from the dryer's location to the wall or roof termination. For each 45°-bend, the maximum length of the duct should be reduced by 2½ feet. For each 90°-bend, the maximum should be reduced by 5 feet.

The maximum length of the exhaust duct does not include the transition duct.

Screens are not permitted on the clothes dryer exhaust vent, as these can trap lint and debris and pose a fire hazard. The exhaust vent should have a damper installed at its termination to prevent debris, rodents, birds and other pests

from enter the exhaust. Check this damper (if accessible) to make sure it's not stuck open or closed.

39.7 Private Wells

A homeowner should know the location of any well on the property. Ideally, wells that supply drinking water are located uphill from the building and from any storm and sanitary sewer system piping. Standards usually require that the well be a minimum of 50 feet from a septic tank, and 100 feet from any part of the absorption field. Local codes may have different separation distances based on the percolation rates of the local soils.

You could remind your client that water quality of a private well can change every year, and that s/he should consider having the water quality tested on a regular basis.

39.8 Septic Systems

Location and Layout

A homeowner should know the layout of the existing septic system.

The absorption field should not be disturbed by new construction or vehicular traffic, or covered by fill, trees or dense vegetation.

No stormwater should be directed into the septic system.

Under proper use, a typical septic system has an average life expectancy of 15 to 20 years.

Septic Tank

If properly maintained, it should be pumped every two to three years. Records related to the pumping should be kept. The lack of periodic pumping will cause solids to be carried into the absorption field, clogging the leaching beds and shortening their useful life.

Signs of a clogged absorption field include the presence of dark

green vegetation over the leaching beds throughout the growing season (which is caused by nutrient-laden wastes being pushed up through the soil), wet or soggy areas in the field, and/or distinct sewage odors.

39.9 Other Exterior Factors

The following are several factors about a home and its property that are often overlooked.

Slope

Look at the property around the house and the slope of the ground. In all seismic regions, including regions of low seismic activity, if the house is on a ground slope of 20° or more, a structural engineer should be consulted to further examine the house in relation to the slope.

Wind

If the property is located in a hurricane or high-wind region, look for loose fences, tree limbs, landscaping materials (such as gravel and small rocks), and other objects that could become windborne debris in a storm.

Floods

Check with local authorities. Major flood-risk zones have been established to define where floods occur, and special flood-resistance requirements have been created for each zone.

Lead

Your client may consider checking for the presence of lead in the soil, which can be a hazard to children playing outdoors and can be tracked indoors on shoes. Lead in soil can come from different sources, such as discarded lead-based paint, lead-based paint chips at the perimeter of stone foundations where the paint is flaking, and old

trash sites where items containing lead have been discarded. The soil and home could be tested for lead by a qualified professional inspector. For more information, visit the U.S. EPA's website to read "Lead in Paint, Dust and Soil."

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. In the context of fire control, defensible space (covered in Section 35) is the area around a structure that has been landscaped to reduce fire danger. Check with the local building official and fire marshal for information on such requirements before reporting any deficiencies or making recommendations.

Construction Expansion and Site Restrictions

If a future construction project on the house includes expansion, an assessment of the site for such future work is critical. The use of the land around the existing house is likely restricted by coverage and setback requirements, which define the areas of the property that can be used for future construction projects.

Homeowner association bylaws and deed covenants sometimes include requirements that can affect changes or additions to a building or outbuilding.

Accessibility

When universal design is a need, consult a code-certified professional inspector for detailed information about parking, walks, patios and egress.

Quiz 18

The chimney _____ is often made of a tapered layer of mortar, called a cement wash, which cracks and breaks after several years.

- cap
- stack
- top
- bottom
- flue

The chimney could lean where it projects above the roof due to deteriorated mortar joints caused either by wind-induced swaying of the chimney, or by sulfate attack from _____.

- flue gases
- the terracotta liner
- outdoor air
- rainwater
- the concrete chimney cap

_____ space refers to the area surrounding a building that is mitigated to protect it from wildfires.

- Defensible
- Indefensible
- Fencible
- Firewall
- Protective

Retaining walls that are taller than _____ inches and not laterally supported at the top should be designed to ensure stability against overturning, sliding, excessive foundation pressure, and water uplift.

- 24
- 12
- 48
- 72

T/F: At a driveway or walkway, the concrete should be no less than 3 inches thick.

- True
- False

T/F: A buried oil tank is within the scope of a home inspection.

- False
- True

T/F: With a few exceptions, all exterior electrical receptacles should have GFCI protection.

- True
- False

T/F: A screen is permitted on a clothes dryer's exhaust vent.

- False
- True

Section 40: A Guide for Homeowners: Water Management & Prevention

Water Management & Damage Prevention

This section provides inspectors with basic information that they can convey to homeowners for making appropriate decisions and taking appropriate actions to keep their homes dry and comfortable. Use this information to effectively communicate with your clients about water management and moisture-damage prevention.

Designing, building and maintaining homes that manage moisture effectively is a process of making good decisions. While builders and designers provide most of the up-front decisions -- such as designing the roof system, and specifying the foundation drainage details -- over the long term, the homeowner must understand basic moisture issues and make good decisions at the right times.

There is already plenty of useful guidance for homeowners on what to do (and not do) regarding moisture. This section does not "reinvent the wheel" but will instead provide basic guidance for homeowners.

This section includes inspection tips that may help an inspector to spot common types of moisture problems during an inspection. Most (if not all) moisture-related problems could become serious and expensive if not taken care of quickly and completely. Therefore, it is important for an inspector to call out or recommend further evaluation and/or repair by qualified professionals when any moisture intrusion is observed.

Houses and Water

Water, in its many forms, is an ever-present fact of life for a homeowner. Households can use hundreds of gallons of tap water on a daily basis. Lots of rainwater must be successfully shed by the roof and siding during rainstorms. Groundwater moves through the soil beneath the foundation. Indoor humidity levels are controlled for comfort. Moisture, in the forms of condensation and water vapor, is absorbed and released by the house itself.

When a well-built home is properly maintained, water is a benefit and a pleasure. On the other hand, uncontrolled water in a home can cause damage. It can lead to mold growth, rotten wood and structural damage.

A House Repels Excess Water

The exterior surfaces of a house, from roof to foundation, make up its envelope or "skin." The skin is designed to shed or repel excess water. If it doesn't, expect trouble. When roof flashings, windows, foundation walls, and other building components are not properly maintained, rainwater will find its way in through vulnerable parts of the house.

A House Absorbs and Releases Excess Moisture

All houses must absorb and release moisture constantly in order to maintain a healthy balance. If the house has "breathing" problems, many types of moisture problems can develop. Trapped moisture -- dampness that cannot be released, for one reason or another -- is one of the primary causes of fungus and mold growth in a house. Fungi can literally eat wood, causing decay, rot and, ultimately, structural damage. Trapped moisture in the walls can destroy the value of the insulation and raise heating and cooling costs. Wood that stays damp attracts carpenter ants and other insects that can accelerate structural problems.

A House Transports Piped Water

Directly beneath the skin of the house is a complex maze of pipes carrying fresh water, as well as drain lines that dispose of water after its use. There are dozens of pipe joints and specialized fittings throughout the house, any one of which can develop a leak and cause moisture damage.

A House Needs a Firm, Dry Foundation

The best foundation is a dry foundation. A water-damaged foundation is extremely expensive to repair and can lead to damage in the rest of the house. Groundwater, floodwater or even rainwater from a misdirected downspout can undermine the foundation and cause settling cracks, wet floors and walls, and other undesirable conditions.

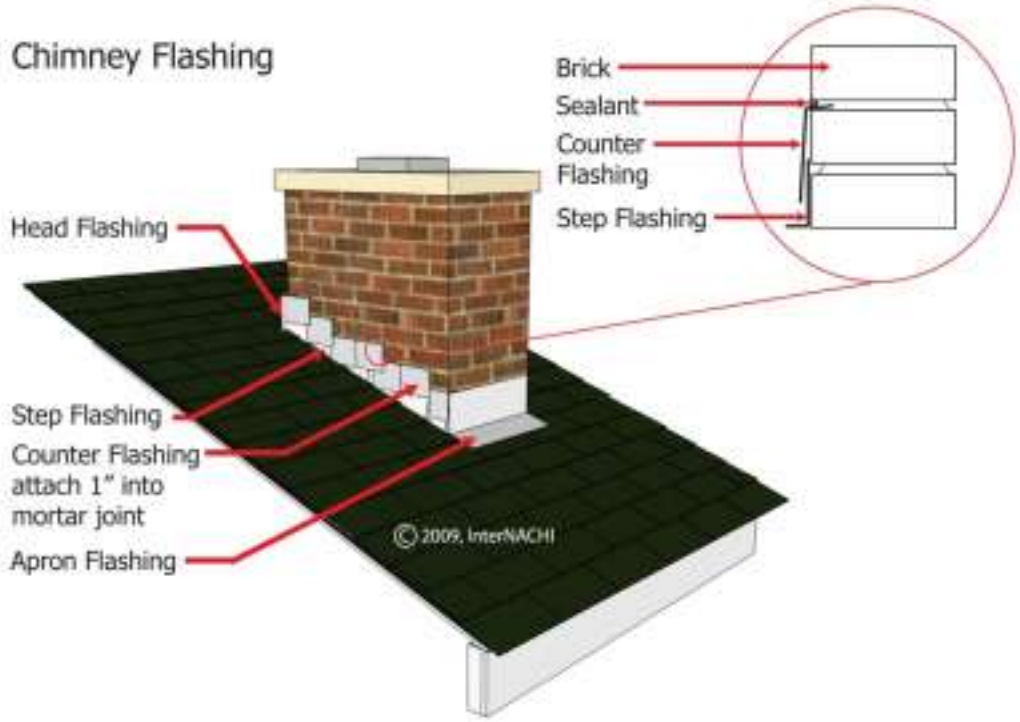
Common Sources of Moisture Damage

Unwanted water can intrude through cracks in the protective skin of the house. It can also accumulate from interior moisture sources.

The following describe the most common sources of moisture problems at the exterior of a house.

Roof and Flashing

Roofing materials can wear out, break, rust, blow off, or otherwise fail and expose the roof deck and structural components beneath to moisture intrusion and damage.



Most leaks occur around penetrations through the roof, such as at a chimney, plumbing vent, exhaust fan and skylight. Flashings and sealant joints around these penetrations can crack, fail and leak. Intersections of roof surfaces with walls are also common leakage points.

Old or defective shingles can curl and crack, allowing moisture intrusion. If old shingles aren't removed before new roof shingles are applied, they can reduce the life of the new roof. Chimney caps can crack, allowing water into interior areas of the chimney.

Shingle edges can fail, forcing rainwater to accumulate between the roof and gutter.

Flat and low-pitched roofs have unique maintenance needs and are susceptible to water problems because they may not drain as quickly as roofs with a steeper pitch.

Flat-roof drains or scuppers can clog and hold water on the roof, increasing the risk not only of a leak, but also of a possible collapse of the entire roof under the weight of the water.

Gutters and Downspouts

Clogged gutters can force rainwater to travel up onto the roof under shingles, or to overflow and travel down the inside of the wall, or to overflow and collect at the home's foundation.

First-floor gutters can overflow if second-floor gutters have been mistakenly directed to drain into them.

An insufficient number of or undersized downspouts can cause gutters to overflow.

Downspouts that don't empty far enough away from foundation walls can lead to foundation wall damage and a wet basement.

Ice Dams

Inadequate attic insulation allows heat to escape from the house into the attic, which can turn rooftop snow into an ice dam along the eaves. Ice dams frequently force moisture to back up under the roof shingles where it can drip into the attic and walls.

Clogged and frozen gutters can act like ice dams, pushing moisture up under the shingles and into the house.

Soffits and Fascia

Damaged soffits (horizontal surfaces under the eaves) can allow snow and rain to be blown into the attic, damaging the insulation, ceilings and walls.

Fascia boards (vertical roof-trim sections) can then become damaged, allowing the moisture from rain and snow into the attic and atop interior walls.

Weep Holes

Weep holes, which are designed to allow moisture to escape from behind walls, can become blocked. Weep holes can freeze, forcing moisture to back up inside the wall cavity. Weep holes can become clogged with landscape mulch, soil and other material.

Landscape and Grading

Landscape modifications may result in water drainage back toward the foundation, rather than away from it.

A newly built home's lot may have been graded improperly, or the original foundation backfill may have settled over time, causing drainage problems.

Automatic sprinklers may be spraying water onto or too close to the foundation walls.

Window and Door Flashing and Seals

Cracked, torn and damaged seals, weatherstripping, and flashing around windows and doors can allow wind-blown moisture to penetrate the house.

Improperly installed windows and doors can allow moisture into the wall. Worn and failed weatherstripping can allow wind-driven rain to penetrate a closed window or door.

Groundwater and Rainwater

Groundwater or misdirected rainwater can collect during wet seasons along the foundation wall or beneath the floor or slab. Unless it is directed away from the structure by a sump pump or corrected drainage, this moisture can lead to mold growth, wall failure, and other destructive moisture problems.

Condensation

Condensation on windows can, at a minimum, damage windowsills and finishes. At

worst, it can damage walls and floors.

Condensation on un-insulated pipes can collect nearby or travel along a pipe to accumulate far from the original source.

Condensation can form inside improperly built walls and lead to serious water damage and biological growth that are hidden from sight.

HVAC

Lapses in regular maintenance can lead to moisture and comfort problems, ranging from clogged drain pans to iced-up cooling coils and mold growth within the system.

Failure to clean and service air conditioners regularly can lead to diminishing performance, higher operating costs, and potential moisture problems.

Humidifiers can add too much moisture to a house, leading to dampness and mold.

Sump Pump

Neglecting to test a sump pump routinely -- especially if it is rarely used -- can lead to severe water damage, especially when a heavy storm, snow melt or flooding sends water against the home.

Overload of the sump pump due to poor drainage elsewhere on the property can lead to pump failure. Frequent sump operation can be a sign of excessive water buildup under the basement floor due to poorly sloped landscaping, poor rain runoff, gutter backflows, and other problems.

Lack of a backup sump pump, which can be quickly installed in the event that the first pump fails, can lead to serious water damage and property loss. This is especially important if the sump pump is relied upon to maintain a dry basement, or if the house is located in an area of seasonally high groundwater. Sump failure can cause extensive water damage and the loss of valuable personal belongings.