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COURSE 962350

Residential Rehabilitation Part 2 - Building Exterior

Review Material

Uscontractorlicense LLC

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Summary Of This Course

RESIDENTIAL REHABILITATION - PART 2 BUILDING EXTERIOR

Approved by the

Wisconsin Department of Safety and Professional Services Safety and Buildings Division

Course Identification Number 962350

Educational Credit Hours: 2 Hours

Course Provider:

USCONTRACTORLICENSE LLC

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

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

This Course is approved for the following electrical Registrations/Certifications or Licenses:

Dwelling Contractor Qualifier	2 Hours of Continuing Education	

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

Course Outline

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

Building Exterior

2.1 Foundation Walls and Piers

2.2 Exterior Wall Cladding

2.3 Windows and Doors

2.4 Decks, Porches, and Balconies

2.5 Pitched Roof Coverings

2.6 Low-Slope Roof Coverings

2.7 Skylights

2.8 Gutters and Downspouts

2.9 Chimneys

2.10 Parapets and Gables

2.11 Lightning Protection

Exam

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

Answer Sheet(s)

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

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

By Email: michael@uscontractorlicense.com

By Fax: 608-571-0096

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

Any questions, please contact us at 608.348.6688

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2 Building Exterior

After the site inspection has been completed, systematically inspect the building's exterior for its condition and weathertightness. Begin either at the foundation and work up or begin at the roof and work down. Examine the quality and condition of all exterior materials and look for patterns of damage or deterioration that should be further investigated during the interior inspection. Determine the building's architectural style and note what should be done to maintain or restore its integrity and character. See Chapter 4 for assessing structural components of the building.

In regions of medium to high seismic activity, buildings with irregular shapes (in either plan or elevation) may be especially vulnerable to earthquakes. Examine the building for such irregularities, and if present, consider consulting a structural engineer.

In hurricane regions, examine screen and jalousie enclosures, carports, awnings, canopies, porch roofs, and roof overhangs to determine their condition and the stability of their fastenings. Then examine the following four critical areas of the exterior to determine their condition and strength: roofs, windows, doors, and garage doors.

In locations where wildfires can occur, some jurisdictions have restrictions on the use of flammable exterior materials. Check with the local building official or the fire marshal, or both, for detailed information.

Additional information on the evaluation and treatment of historic building exteriors is presented in the *Secretary of the Interior's Standards for Rehabilitation*, available full text online at http://www2.cr.nps.gov/tps.

When universal design is a part of a rehabilitation, consult HUD publication *Residential Remodeling and Universal Design* for detailed information about entrances, doors, and decks.

2.1 Foundation Walls and Piers

Foundation walls and piers in small residential buildings are usually made of masonry and should be inspected for cracking, deterioration, moisture penetration, and structural adequacy. See Sections 4.3 and 4.4. Wood posts and columns and concrete foundations and piers should be inspected in accordance with Sections 4.7 and 4.9.

2.2 Exterior Wall Cladding

Exterior walls above the foundation may be covered with a variety of materials, including wood siding or its aluminum and vinyl substitutes, wood or asbestos cement shingles, plywood with and without a medium density (plastic) overlay, stucco, brick or stone masonry, and an exterior insulation and finish system. These materials are designed to serve as a weathertight, decorative skin and, in warm climates should be light in color to reduce heat absorption. Inspect exterior claddings as follows:

- **Exterior wood elements.** Inspect all painted surfaces for peeling, blistering, and checking. Paint-related problems may be due to vapor pressure beneath the paint, improper paint application, or excessive paint buildup. Corrective measures for these problems will vary from the installation of moisture vents to complete paint removal. Mildew stains on painted surfaces do not hurt the wood and may be cleaned with a mildew remover.

  All wood elements should be checked for fungal and insect infestation at exposed horizontal surfaces and exterior corner joints, as specified for wood structural components in Section 4.7.

  Check the distance between the bottom of wood elements and grade. In locations that have little or no snow, the distance should be no less than six inches. In locations with significant, lasting snow, the bottom of wood elements should be no less than six inches above the average snow depth.

- **Aluminum and vinyl siding.** Aluminum and vinyl siding may cover up decayed or insect-infested wood but otherwise are generally low maintenance materials. Check for loose, bent, cracked, or

A second layer of shingles has filled the former gap between roof and zsiding, causing the siding to deteriorate. Shingles are cupped and beginning to fail as well.

The stucco is beginning to erode on this structure due to a poor roof drainage detail. A longer scupper would solve this problem.

broken pieces. Inspect all caulked joints, particularly around window and door trim. Many communities require aluminum siding to be electrically grounded; check for such grounding.

- **Asbestos cement shingles.** Like aluminum and vinyl siding, asbestos cement shingles may cover decayed or insect-infested wood. Check for loose, cracked, or broken pieces and inspect around all window and door trim for signs of deterioration.
- **Stucco.** Check stucco for cracks, crumbling sections, and areas of water infiltration. Old and weathered cracks may be caused by the material's initial shrinkage or by earlier building settlement. New, sharp cracks may indicate movement behind the walls that should be investigated. Refer to Section 4.5 for problems with masonry walls. It is difficult to match the color of stucco repairs to the original stucco, so plan to repaint surrounding stucco work where sections are mended.

- **Brick or stone veneers.** Inspect veneers for cracking, mortar deterioration, and spalling. Refer to Sections 4.3 and 4.5 for the inspection of above-ground masonry walls.
- **Exterior insulation and finish systems (EIFS).** EIFS, also known as synthetic stucco, has been in widespread residential use since the early 1990s. It generally consists of the following product layers (moving outward): insulation board, mesh and base coat layer, finish coat, and sealant and flashing.

  EIFS was originally designed as a nondraining water and moisture barrier system. A drainage-type EIFS that allows water and moisture to penetrate the surface and then drain away has been developed more recently. Most existing EIFS in residential applications is installed over wood framing and is of the nondraining type. Water leakage and consequent rotting of the wood framing have become serious problems in many installations, especially at wall openings such as windows and doors, where inadequate flashing details can allow water seepage into the wall interior.

  Manufacturers of EIFS differ in their installation methods. Inspecting existing EIFS is difficult because it is a proprietary product and there are no standard construction details. Use a trained specialist to check for concealed water damage and rot.

Exterior walls of older buildings usually contain no thermal insulation. Examine behind the cladding when possible to determine the presence of insulation, if any, and assess the potential for insulating the exterior walls.

Where mildew and mold are evident on exterior cladding or where interior walls are damp, there is the possibility that condensation is occurring in the walls. Moisture problems generally occur in cold weather when outside temperatures and vapor pressures are low and there are a number of water vapor sources within the building. The presence of moisture may be a result of an improperly installed or failed vapor barrier, or no vapor barrier at all. If condensation is suspected, an analysis of the wall section(s) in question should be made. This analysis will provide the information necessary to make the needed repairs.

2.3 Windows and Doors

Windows and doors are the most complex elements of the building's exterior and should be inspected from the outside as follows:

- **Exterior doors** should be examined for their condition, overall operation and fit, and for the functionality of their hardware. Door types include hinged, single and double doors of wood, steel, aluminum, and plastic with and without glazing. Check wood and plastic doors that are not protected from the weather. These doors should be rated for exterior use.

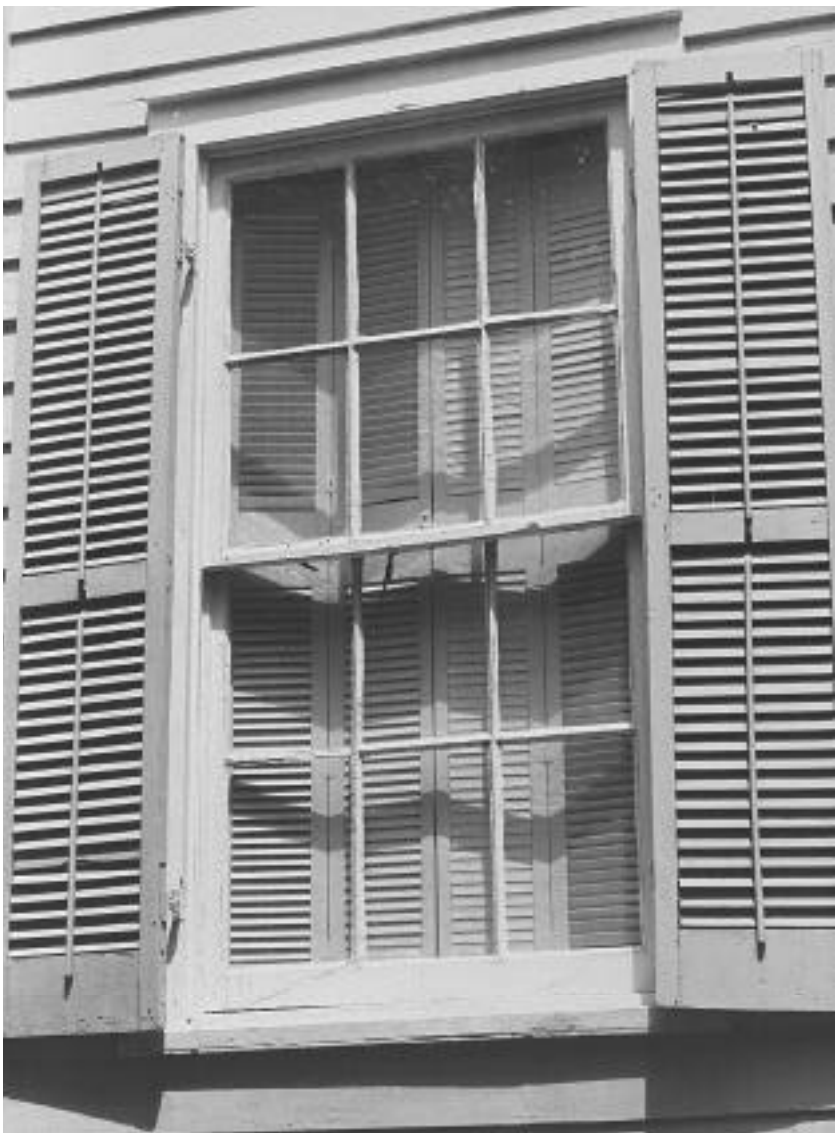
  In warm climates, jalousie doors may also be in use. Check these doors to make sure the louvers close tightly and in unison for weathertightness.

  Some buildings use glass framed doors of fixed and operable panels that have wood, vinyl-covered wood, and aluminum frames. Check the track of these sliding doors for dents, breaks, and straightness. Check the glides of operable panels for wear and check the sealing of fixed panels for weathertightness. Note the degree of physical security offered by doors and their locksets and pay special attention to pairs of hinged and sliding doors.

  Doors also should be inspected for the exterior condition of their frames and sills. Check doors that are not protected from the weather for the presence of essential flashing at the head.

  Glazing on exterior doors should be examined as described in the following section on windows. The interior condition and hardware of exterior doors will be examined during the interior inspection.

  In hurricane regions, check exterior doors, and especially double doors, for the presence of dead-bolt locks with a throw length of no less than one inch.
- **Windows** should be inspected for the exterior condition of their frames, sills and sashes, and for overall operation and



The glazing putty in this window is deteriorated in some locations. Repairs will be time consuming.

fit. The interior condition and hardware of windows will be examined during the interior inspection. There are eight types of windows and six types of frame material in general use in residential buildings. Frame materials are plastic, aluminum, steel, wood, plastic-clad wood, and metal-clad (steel or aluminum) wood. Window types are double hung, single hung, casement, horizontal sliding, projected out or awning, projected in, and fixed. In addition to these, there are jalousies: glass louvers on an aluminum or steel frame.

The glazing compound or putty around glass panels in older sashes should be examined especially carefully since this is often the most vulnerable part of the window and its repair is time consuming. Examine glazing tapes or strips around glass panels in steel or aluminum sashes for signs of deterioration such as hardened sealant or poor fit. Check metal sashes for weep holes that have been blocked by paint, sealant, or dirt. Weep holes are usually easy to clean. Check windows that are not protected from the weather for the presence of essential flashing at the head.

For windows close to the ground or easily accessible from flat roofs, note the degree of physical security provided by the windows and their locks.

In hurricane regions, check all windows and glass doors that are not protected by shutters to determine if they have been tested for impact resistance to windborne debris. If they have not been so tested, determine if plywood panels can be installed for their protection at the time of a hurricane warning.

- **Weather stripping.** Window and door weather stripping is generally of three types: metal, foam plastic, or plastic stripping. Check each type for fit. Check metal for dents, bends, and straightness. Check foam plastic for resiliency and plastic stripping for brittleness and cracks. Make sure the weather stripping is securely held in place.

- **Shutters.** 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 and its mounting to the wall. Functional shutters are operable and can be used to close off a window. Assess the adequacy of these shutters for their purpose: privacy, light control, security, or protection against bad weather. Check their operation and observe their condition and fit.

  Shutters close to the ground can be examined from the ground. Shutters out of reach from the ground should be examined during the interior inspection when windows are examined.

  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.

- **Awnings.** Windows and glazed exterior doors sometimes have awnings over them, usually for sun control, but sometimes for decoration or protection from the weather. 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. Check the condition of awnings. Assess the adequacy of the attachment to the exterior wall. Fold up and unfold operable awnings and note the ease of operation. If an awning is used for sun control, assess its effectiveness and its effect on energy conservation.

- **Storm windows and doors** should be examined for operation, weathertightness, overall condition, and fit. Check the condition of screen and glass inserts; if they are in storage, locate, count, and inspect them. Check also to determine if the weep holes have been blocked by paint, sealant, dirt, or other substances. Opening weep holes is usually easy to do.

- **Garage doors** should be examined for operation, weathertightness, overall condition, and fit. Doors without motors should be manually opened and closed. Doors with motors should be operated using each of the operators on the system (key lock switch or combination lock key pad where control must be accessible on the exterior, remote electrical switch, radio signal switch, or photoelectric control switch). Check the operation for smoothness, quietness, time of operation, and safety. Check for the presence and proper operation of the door safety reversing device. Observe exposed parts of the installation for loose connections, rust, and bent or damaged pieces.

  Garage doors are made of wood, hardboard on a wood frame, steel, glass fiber on a steel frame, glass fiber, and aluminum. All come with glazed panes in a wide variety of styles. Check wood and hardboard for rot and water damage, check hardboard for cracking and splitting, check steel for rust, check glass fiber for ultraviolet light deterioration, and check aluminum for dents.

  In hurricane regions, examine garage doors, especially single doors on two-car garages, to determine if the assembly (door and track) has been tested for hurricane wind loads or has been reinforced.

- **Safety Glazing.** Glazed entrance doors including storm doors, sliding glass patio doors, and glazing immediately adjacent to these doors, but excluding jalousie doors, should be fully tempered, wire, or laminated glass or an approved plastic material. In addition, glazing adjacent to any surface normally used for walking must be safety glazing. Safety glazing is a building code requirement that applies to both new and replacement glazing.

2.4 Decks, Porches, and Balconies

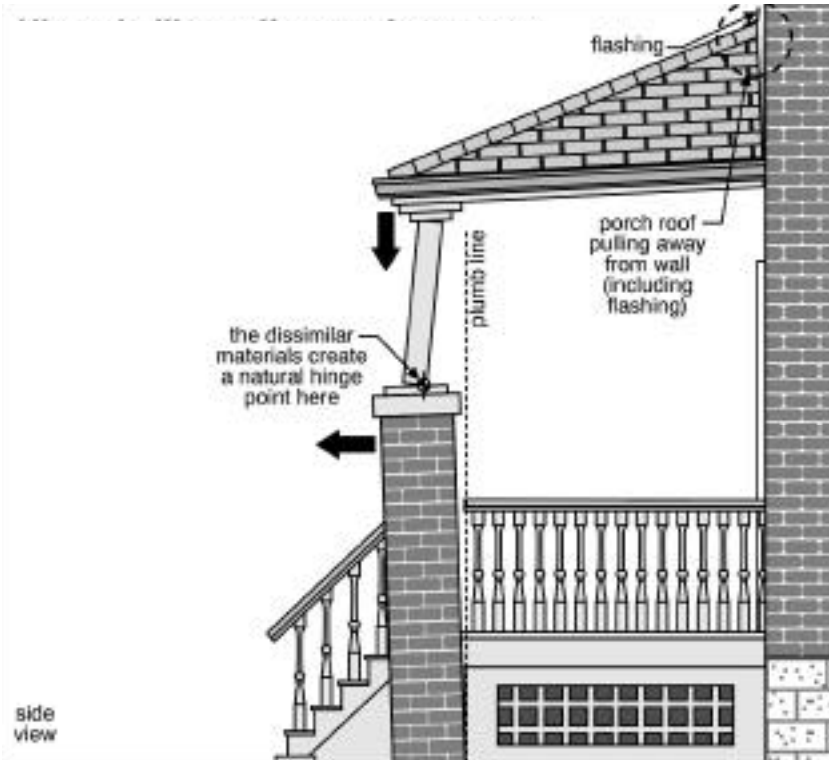
Decks, porches, and balconies are exposed to the elements to a greater extent than most other parts of a building and are therefore more susceptible to deterioration. Inspect for the following:

- **Condition.** Examine all porch, deck, and balcony supports for signs of loose or deteriorated

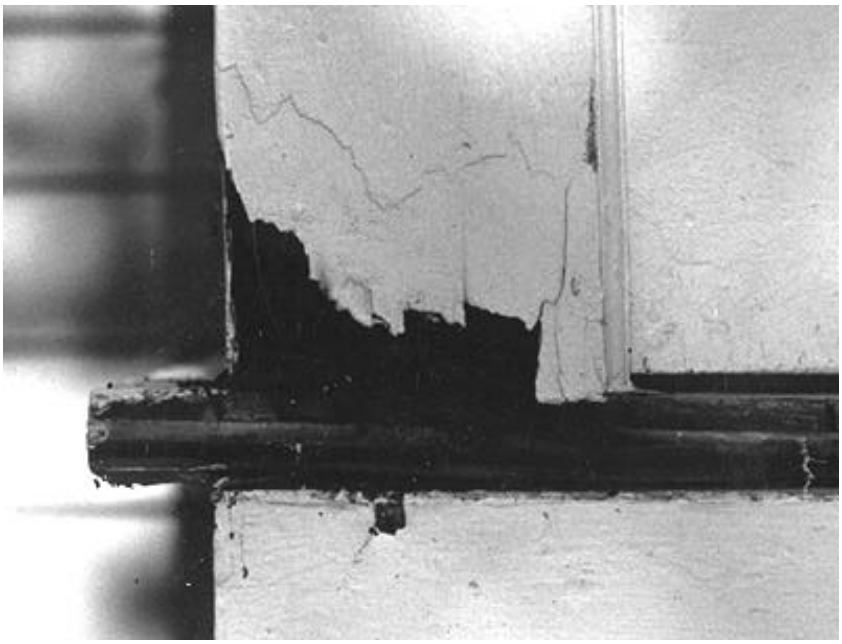
components. See Section 4.7 for the inspection of wood structural components. Masonry or concrete piers should be plumb and stable; check them in accordance with Section 4.4. Make sure that structural connections to the building are secure and protected against corrosion or decay.

Examine porch floors for signs of deflection and deterioration. Where the porch floor or deck is close to the level of the interior floor, look for signs of water infiltration at the door sill and check for a positive pitch of the porch floor or deck away from the exterior wall.

- **Exterior railings and stairs.** Inspect the condition of all exterior stairs and railings. Every stair with more than three steps should have a handrail located 34 to 38 inches (865 to 965 mm) above the edges of the stair tread. Shake all railings vigorously to check their stability, and inspect their fastenings. Most codes for new construction require that porches, balconies, and decks located more than 30 inches (760 mm) above the ground have guards not less than 36 inches (915 mm) high and intermediate rails that will not allow the passage of a sphere 4 inches (100 mm) in diameter. Check wooden steps for proper support and strength and for rot and insect infestation. Inspect steel stairs for rust, strength, and attachment. Deteriorated stairs should be repaired or replaced.



The joint between the two parts of this support creates a hinge that can affect the roof structure.

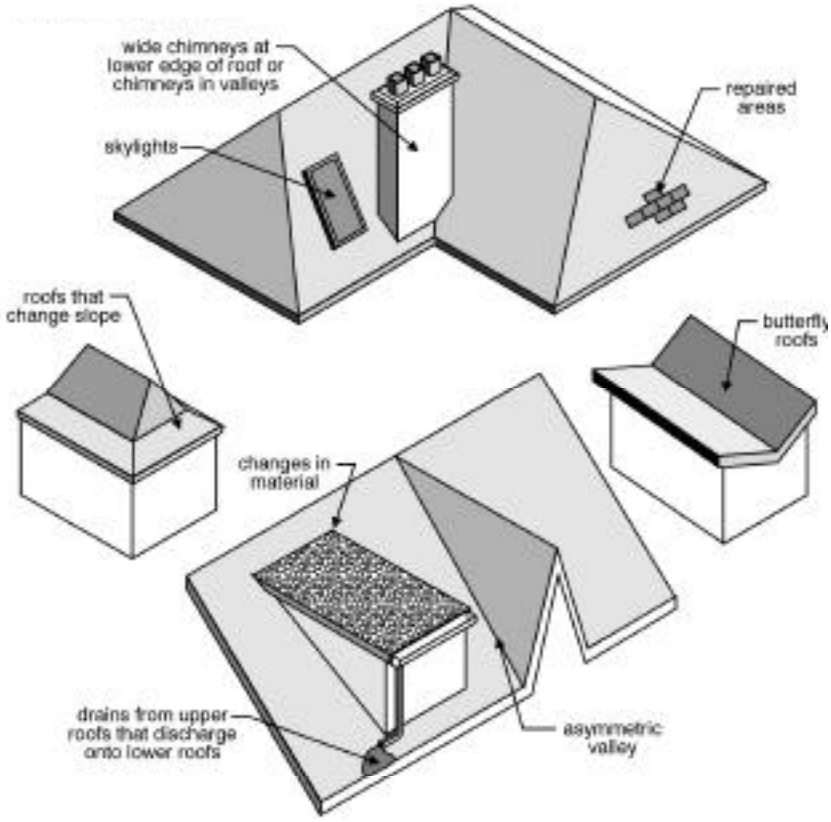


A rotted corner post on a screened porch. In this case, the rotted section of the post and a small section of the floor beneath it were removed and replaced with sound wood.

Stair treads should be as level as possible without holding water. Stair riser heights and tread depths should be, respectively, uniform.

2.5 Pitched Roof Coverings

Pitched or steep sloped roofs are best inspected when direct access is gained to all their surfaces. Use binoculars to inspect roofs that are inaccessible or that cannot be walked on. Look for deteriorated or loose flashing, signs of damage to the roof covering, and valleys and gutters clogged with debris. Carefully examine exterior walls and trim for deterioration beneath the eaves of pitched roofs that have no overhang or gutters. There are four categories of pitched roof covering materials and their condition should be checked as follows:



Vulnerable roof areas

- **Asphalt shingles.** Asphalt or "composition" shingles have a service life of about 20 years for the first layer and about 15 years for a second layer added over the first layer, depending on their weight, quality, and exposure. When they begin to lose their granular covering and start to curl they should be replaced. No more than two layers of asphalt shingles should normally be in place at any one time. If a second layer of asphalt shingles has been applied, check to see if all the flashing materials (galvanized steel, aluminum, rubber) in the first layer were removed and replaced with new flashing at the second layer.

  Check the roof slope. A slope of 4 in 12 or steeper is referred to as normal. A slope of between 3 in 12 and 4 in 12 is referred to as low. No asphalt shingle roof should be less steep than 3 in 12. If the roof has a normal slope, check the underlayment if possible. It should be at least a single layer of 15-pound (6.8 kg) asphalt saturated felt. Low-slope roofs should have at least two such felt layers. If ice dam flashing at overhanging eaves is needed (see Section 2.8) or present, make sure it extends three feet beyond the plane of the interior face of the exterior wall below for a low-slope roof and two feet for a normal-slope roof.

- **Wood shingles or shakes.** This type of covering has a normal life expectancy of 25 to 30 years in climates that are not excessively hot and humid, but durability varies according to wood species, thickness, the slope of the roof, whether shingles are made of heartwood, and whether they have been periodically treated with preservative. Shakes are hand-

This slate roof should be carefully investigated since it has a makeshift repair. Other problems include the chimney, which is too low, and the vent pipe, which is too narrow.

split on at least one face and either tapered or straight. Shingles are sawn and tapered. Check the roof slope. The minimum slope for wood shingles is 3 in 12 and the minimum slope for shakes is 4 in 12. As wood shingles and shakes age, they dry, crack, and curl. In damp locations they rot. Replace them when more than one-third show signs of deterioration. These materials are easily broken. They should not be walked on during the inspection. If the roof is historic or relatively complex, consult a wood roofing specialist.

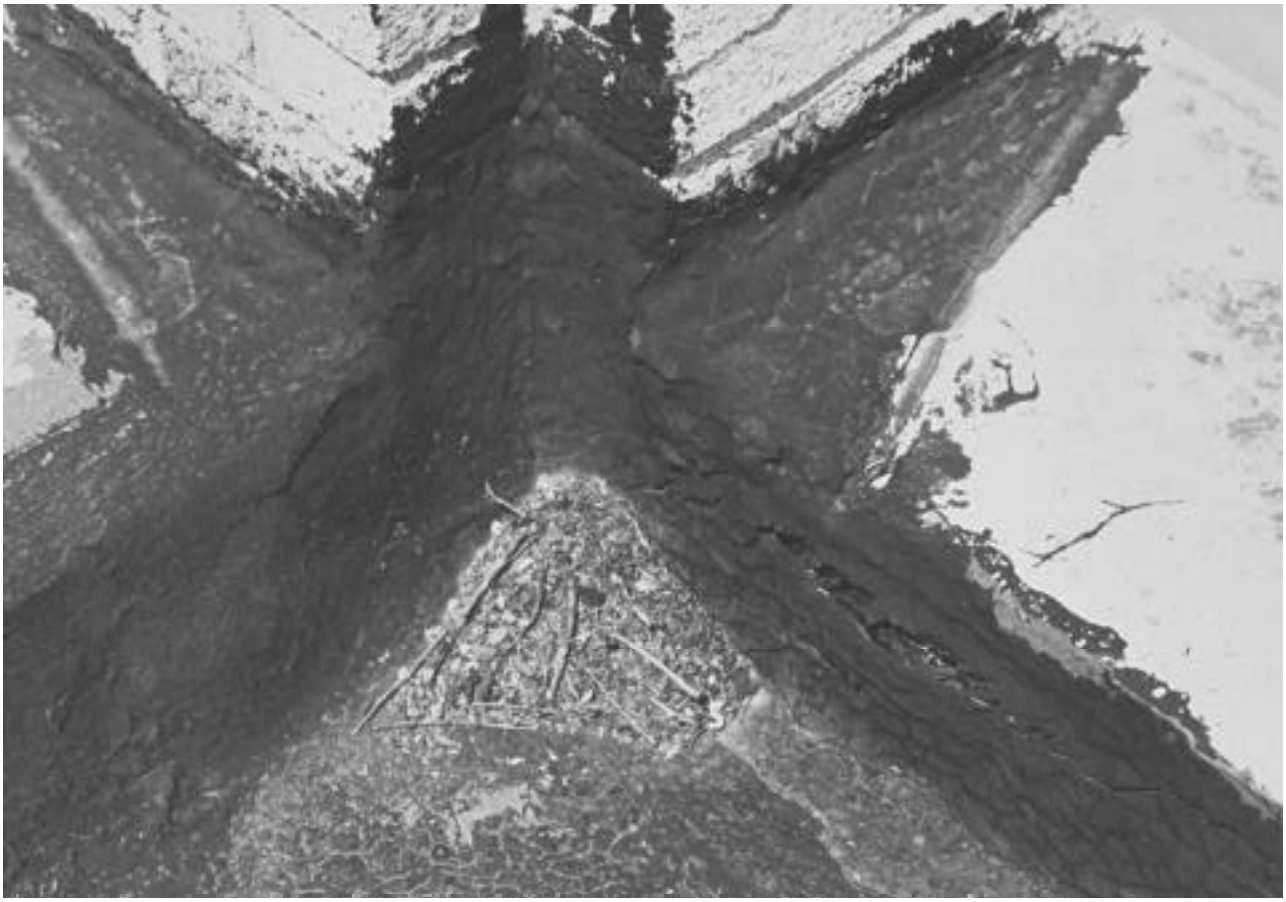
- **Metal roofing.** Metal can last 50 years or more if properly painted or otherwise maintained. Metal roofs may be made of galvanized iron or steel, aluminum, copper, or lead; each material has its own unique wearing characteristics. Inspect metal roofs for signs of rusting or pitting, corrosion due to galvanic action, and loose, open, or leaking seams and joints. The slope of metal roofing can be from one-half inch per foot (1:24) to very steep. The types of metal, seams, and slope determine the construction details. There are three basic seam types—batten, standing, and flat—as well as flat and formed metal panels. Snow guards are needed on steeper slopes and in locations with heavy, long-lasting snow, bracket and pipe snow guards also may be necessary. Low-slope metal roofs that are coated with tarlike material are probably patched or have pin holes and cannot be counted on to be leak-free. If the roof is historic or relatively complex, consult a metal roof specialist.

- **Slate, clay tile, and asbestos cement shingles.** These roof coverings are extremely durable and, if of high quality and properly maintained, may last the life of the structure. Check the roof slope. The minimum slope for roofs of these materials is 4 in 12. Slate shingles should be secured by copper nails except in the very driest of climates; look at the underside of the roof sheathing in the attic or check the nails on broken shingles. Nail heads should be covered with sealant. Nails for tile roofs should be non-corroding. All of these roof coverings are brittle materials and easily broken, and should not be walked on during the inspection. Use binoculars to look for missing, broken, or slipping pieces. Slate is particularly susceptible to breakage by ice or ice dams in the winter, and should therefore be especially well drained. Snow guards are needed on steeper slopes, and in locations with heavy, long-lasting snow, snow guards also may be necessary. Moss will sometimes grow on asbestos cement shingles; it should be removed with a cleaner to prevent capillary water leaks. Slate, clay tile, and asbestos shingles should be repaired or replaced by a qualified roofer.

Examine the underside of the roof later during the interior inspection.

2.6 Low-Slope Roof Coverings

A roof that is nearly level or slightly pitched is called a low-slope roof. No roof should be



The built-up roof and flashings in this photograph are in poor condition. Patching may work temporarily, but the roof and flashings should be replaced.

dead level flat; it must have at least a slight slope to drain. Problems in low-slope roofs are common and more difficult to diagnose than pitched roof problems because the path of water leakage through flat roofs is often quite hard to trace. Look for signs of ponded water due to either improper drainage or sagging of the roof deck. If the cause is a sagging deck, it should be structurally corrected before it worsens. Low-slope roofs are expensive to repair, so extra care should be taken in their examination.

Inspect the flashing and joints around all roof penetrations, including drains, soil stacks, chimneys, skylights, hatchways, antenna mountings, and other roof-mounted elements. Note if metal flashings need painting or reanchoring and if asphaltic or rubber flashings are brittle or cracked. Check parapet wall caps and flashing for signs of damage due to wall movement.

Examine all portions of the roof covering. Look for signs of previous repairs that may indicate trouble spots. There are four categories of low-slope roof covering materials and they should be inspected as follows:

- **Built-up roofing.** Built-up roofs are composed of several layers of roofing felt lapped and cemented together with bituminous material and protected by a thin layer of gravel or crushed stone. Built-up roofs vary greatly in life span, but those used in residential buildings usually last about 20 years, depending on their quality, exposure, number of plies, and the adequacy of their drainage. Because built-up roofs are composed of several layers, they can contain moisture in the form of water or water vapor between layers. Moisture not only accelerates deterioration, it can also leak into a building. Look for cracking, blistering, alligatoring, and wrinkling, all of which may indicate the need for roof replacement or repair. Consult an experienced roofer for a further evaluation if you are in doubt.

  Test: An infrared or nuclear scanner can be used to detect areas of moisture in built-up roofs. Once located, these areas can be more thoroughly checked with a moisture meter or a nuclear meter. Such tests must be performed by a trained roofing inspector and are normally used to determine areas that need replacement on very large roofs.

- **Single-ply membrane roofing.** A single-ply membrane roof consists of plastic, modified bitumen, and synthetic rubber sheeting that is laid over the roof deck, usually in a single ply and often with a top coating to protect it from ultraviolet light degradation. Single-ply roofs are installed in three basic ways: fully adhered, mechanically attached, and loose laid with ballast. If properly installed and properly maintained, a single-ply roof should last 20 years. Roof penetrations and seams are the most vulnerable parts of single-ply membrane roofing and should be carefully checked. The material is also susceptible to ultraviolet light deterioration. A protective coating can be used to protect it, but the coating should be reapplied periodically. Check carefully for surface degradation on an unprotected roof and fading of the coating on a protected roof. Check also for signs of water ponding and poor drainage.

- **Roll roofing.** Roll roofing consists of an asphalt-saturated, granule-covered roofing felt that is laid over the roof deck. It can only provide single- or two-ply coverage. Inspect roll roofing for cracking, blistering, surface erosion, and torn sections. Seams are the most vulnerable part of roll roofing, and should be carefully checked for separation and lifting. Also check for signs of water ponding and poor drainage.

- **Metal roofing.** See Section 2.5.

The underside of the low-slope roof should be examined during the interior inspection. If it is inaccessible, look for signs of water leakage on interior ceilings and walls.

2.7 Skylights

From the exterior, check all skylights for cracked or broken glazing material, adequate flashing, and rusted or decayed frames. Skylights will be checked again during the interior inspection. Leaking skylights are common. Replacement skylights must comply with the building code.

The gutters on this low-slope roof are deteriorating largely because of the accumulated detritus that they hold. They should be inspected and cleaned periodically.

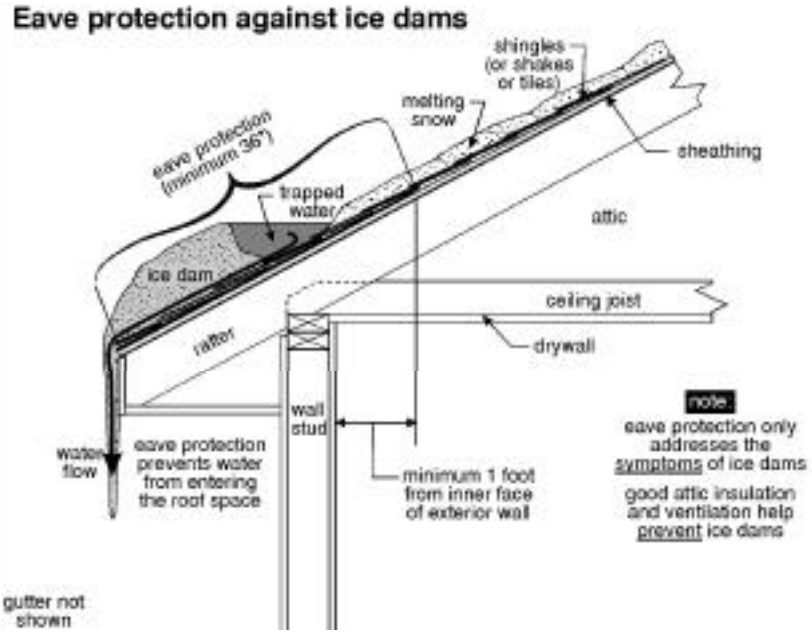
2.8 Gutters and Downspouts

Buildings with pitched roofs can have a variety of drainage systems. With a sufficient overhang, water can drain directly to the ground without being intercepted at the roof edge. See Section 1.1. Usually, pitched roofs end in gutters that are drained by downspouts.

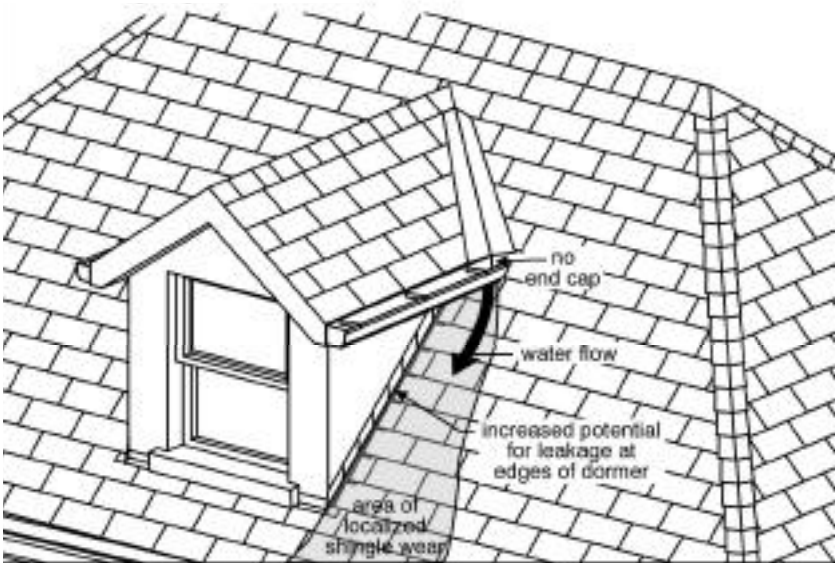
Low-slope roof drainage is accomplished in one of three ways: without gutters or downspouts, with gutters and downspouts, or by downspouts that go down through a building's interior. Drainage without gutters and downspouts can damage the exterior wall with overflow. If the roof has no gutters and downspouts or interior downspouts, carefully examine the exterior walls for signs of water damage.

Gutter and downspout materials are usually galvanized steel, aluminum, copper, or plastic.

- **Gutters** should have a minimum ratio of gutter depth to width of 3 to 4; the front edge should be one-half inch (13 mm) lower than the back edge; and four inches is considered the minimum width except on the roofs of canopies and small porches. Make certain all gutters are clean and slope uniformly, without low areas, to downspouts. If there is a screen or similar device to prevent anything but water from flowing into the gutter, check its condition, fit, and position, to be sure water really can enter the gutter. Check gutters without screens or similar devices to be sure that basket strainers are installed at each downspout. Check the physical and functional



Eave protection against ice dams



Dormer gutters improperly discharging onto the roof

condition of all gutters. Joints should be soldered or sealed with mastic. Also examine the placement of gutters: the steeper the roof pitch, the lower the gutter placement. On roofs with lower slopes make sure gutters are placed close to the roof's surface. Hangers should be placed no more than three feet apart. Where ice and snow are long lasting, hangers should be placed no more than 18 inches (460 mm) apart. Wherever a gutter is exposed, check the strength of its fastening to the roof fascia or building exterior. Rusted fasteners and missing hangers should be replaced.

- **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 30 ºF (-1 ºC) or less. 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 freezes and forms an ice dam just above the gutter. The ice dam traps water from melting snow and forces it back under the shingles and into the building's interior. Check the edge of the roof overhang for evidence of ice dams and observe the eaves and soffit for evidence of deterioration and water damage. Check gutters and the immediately adjacent roofing for the presence of electrical de-icing cables, which may be evidence

of an ice dam problem. When the interior inspection is made, check the inside of exterior walls and adjacent ceilings for signs of water damage. If the house has an attic, check the underside of the roof deck at exterior walls for signs of water damage.

- **Downspouts** should be checked for size. Seven square inches is generally the minimum except for small roofs or canopies. Check downspout attachments; there should be attachments or straps at the top, at the bottom, and at each intermediate joint. Check straps for rust, deformation, and failed or loose fasteners. Check the capacity of the drainage system. At least one downspout is usually needed for each 40 feet (12 m) of gutter. For roofs with gutters, make sure that downspouts are clear and that they discharge so water will drain away from the foundation. See Section 1.1. For low-slope roofs without gutters, interior downspouts cannot be examined from the roof, but check that basket strainers are in place. During the interior inspection, examine areas through which interior downspouts pass for signs of water damage.

  On buildings with multiple roofs, one roof sometimes drains to another roof. Where that happens, water should not be discharged directly onto roofing material. Check to be sure that water is always directed to a gutter and that higher gutters discharge to lower gutters through downspouts.

  Occasionally, wooden gutters and downspouts are used, usually in older or historic residences. They may be built into roof eaves and concealed by roof fascias. Wooden gutters are especially susceptible to rot and deterioration and should be carefully checked.

  Pitched roofs in older buildings may end at a parapet wall with a built-in gutter integrated with the roof flashing. Here, drainage is accomplished by a scupper (a metal-lined opening through the parapet wall that discharges into a leader head box that in turn discharges to a downspout). Check the leader head box to be sure it has a strainer. Check the scupper for deterioration and open seams and check all metal roof flashings, scuppers, leader head boxes, and downspouts to make certain they are made of similar metals.

2.9 Chimneys

Chimneys should project at least two feet above the highest part of a pitched roof and anything else that is within 10 feet (3 m). A chimney should project at least three feet from its penetration from the roof (required minimum heights may vary slightly). Check the local building code. If the chimney is not readily accessible, examine what you can with binoculars from the highest vantage point you can find.

Flues should not be smaller in size than the discharge of the appliance they serve. The minimum flue area for a chimney connected to a fireplace is normally 50 square inches (320 cm^2) for round linings, 64 square inches (410 cm^2) for rectangular linings, and 100 square inches (650 cm^2) for an unlined chimney. Be extremely cautious about unlined chimneys; check the local building code. Flues should extend a minimum of four inches above the top of a masonry chimney. The height between adjacent flues in a multiple flue chimney without a hood should vary approximately four inches to avoid downdrafts. The same is true of a chimney with a hood unless a withe of masonry completely separates every flue.

Masonry chimneys without hoods should have stone or reinforced concrete caps at the top. Cement washes with or without reinforcing mesh are also used, but they are the least durable. Some masonry chimneys have hoods over the flues. Hoods on masonry chimneys consist of stone or reinforced concrete caps supported on short masonry columns at the perimeter of chimney tops, or sheet metal caps supported on short sheet metal columns. The height of a hood above the top of the highest flue should be at least 25 percent greater than the narrowest dimension of the flue.

Check the condition of chimney tops and hoods. If a cement wash is not properly sloped or is extensively cracked, spalled, or displays rust stains, it should be replaced. Reinforced concrete

caps and stone caps with minor shallow spalling and cracking should be repaired. Those with extensive spalling or cracking should be replaced. Sheet metal hood caps with minor rust or corrosion should be repaired, but if rust or corrosion is extensive, replacement is needed.

Metal spark screens are sometimes used on wood and coal-burning fireplace chimneys. Check the condition and fit of spark screens. Dirty or clogged screens adversely affect draft and should be cleaned.

Where a masonry chimney is located on the side of a pitched roof, a cricket is needed on the higher side to divert water around the chimney. Check the cricket to be sure that its seams are watertight, that it is properly flashed into the chimney and roofing, and that it extends the full width of the chimney.

In seismic zones, check the bracing of masonry chimneys from the top of the firebox to the cap, and particularly the portion projecting above the roof. Consider consulting a structural engineer to determine the need for additional bracing or strengthening.

If the chimney is prefabricated metal encased in an exterior chase of siding, check the chase top to be sure it is properly interlocked with the metal chimney's counterflashing so that the assembly is watertight. Also check the chase top for slope: water should drain off the enclosure. Check for the presence of a terminal metal rain cap and make certain the flue terminates not less than two inches and not more than eight inches above the enclosure top.

If the chimney is prefabricated metal and not encased, check the adjustable flashing at the roof to be sure it is tightly sealed to the chimney, preferably with counterflashing, and check for the presence of a stack cap.

2.10 Parapets and Gables

In seismic zones, check the bracing of masonry parapets and gables. Consider consulting a structural engineer to determine the need for additional bracing or strengthening.

2.11 Lightning Protection

Lightning is a problem in some locations. Check the local building code. Lighting protection may be required to prevent powerline surge damage to electrical service, telephone service, or radio and television leads; to protect tall trees close to buildings; or to protect an entire building.

A lightning protection system is an interconnected aggregation of lightning rods, bonding connections, arresters, splicers, and other devices that are installed on a building or tree to safely conduct lightning to the ground. Lightning protection components and systems are identified by Underwriters Laboratories in three classes. Class I includes ordinary buildings (including residences) under 75 feet (22 m) in height. A Class I lightning protection system consists of lightning rods located on the roof and on projections, such as chimneys; main conductors that tie the lightning rods together and connect them with a grounding system; bonds to metal roof structures and equipment; arresters to prevent powerline surge damage; and ground terminals, usually rods or plates driven or buried in the earth. Lightning protection systems should be examined by a certified technician.

Using Appendix D, consult the following sources for technical information about lightning protection systems:

- Lightning Protection Institute, *Installation Code*, LPIB175.
- National Fire Protection Association, NFPA 780, *Standard for the Installation of Lightning Protection Systems*.
- Underwriters Laboratories, Inc., UL 96, *Lightning Protection Components* and UL 96A, *Installation Requirements for Lightning Protection Systems*.