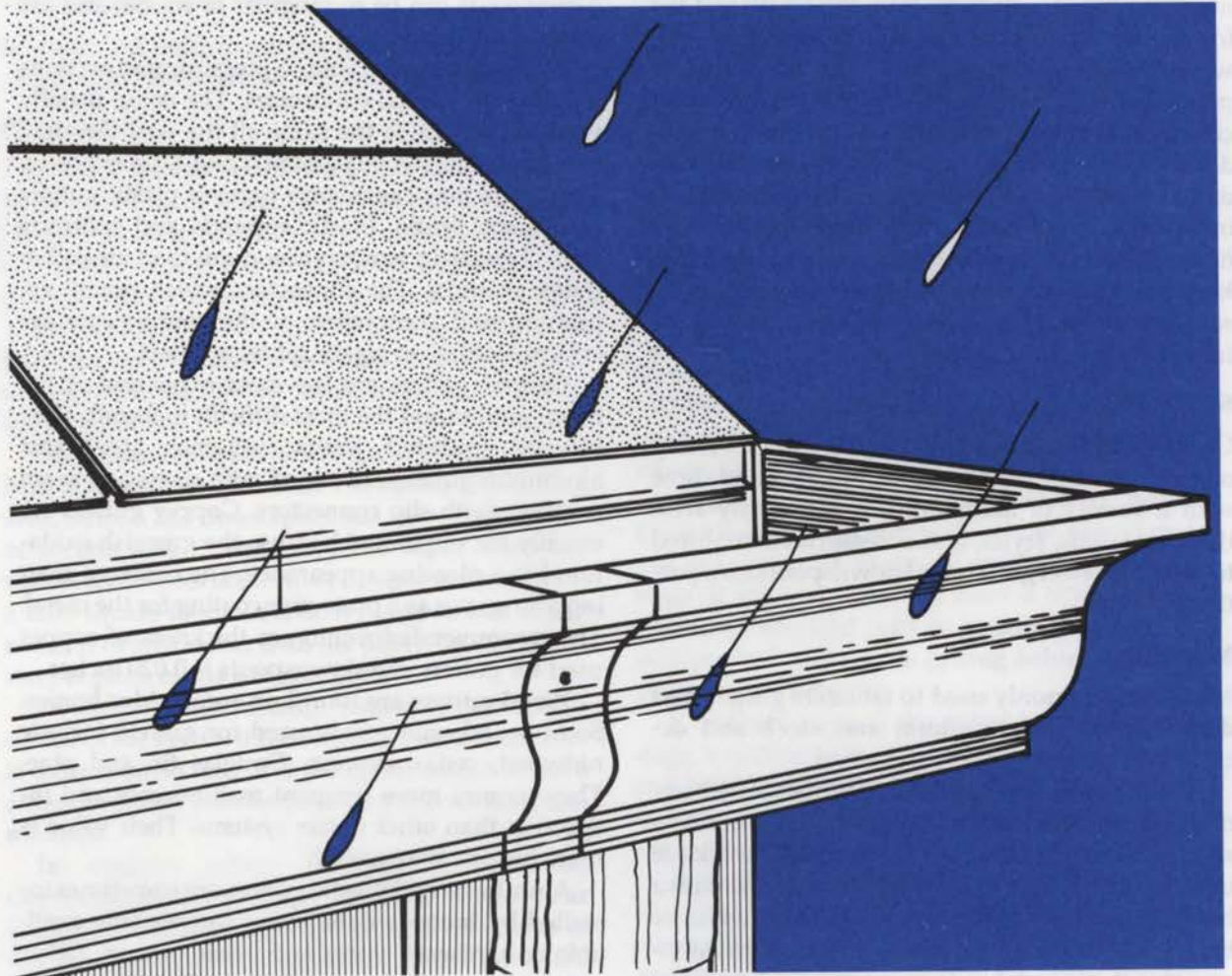
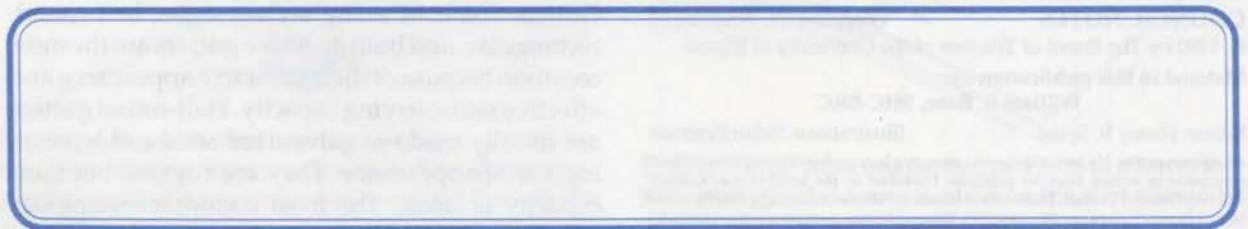


GUTTERS AND DOWNSPOUTS FOR THE HOME



Small Homes Council-Building Research Council
University of Illinois at Urbana-Champaign



On homes with simple roofs, large overhangs, and good site drainage, gutters and downspouts may not be necessary. But for most homes, gutters and downspouts are strongly recommended. Gutters and downspouts may be used on any roof, but they should always be used in regions with significant rainfall where roof overhangs are less than 12 inches in width for one story or 24 inches in width for two stories.

When water lands on the roof as rain or snow, it must be carried well away from the house and the foundation. Many house problems result from rainwater which collects around the house. Most problems of dampness in basements and crawlspaces can be readily traced to the failure to divert rainwater away from the soil near the foundation. (This is usually due to gutters which drain incorrectly or to soil which slopes toward the house.) Gutters and downspouts are also needed to keep roof rain water from eroding or expanding the soil, from damaging siding and wall framing, or from dropping on an entry area.

SELECTION

Gutters and downspouts are made from a variety of materials, are available in many styles, and come with a variety of accessories. A familiarity with these materials, styles, and accessories is required to properly select gutters and downspouts for a particular house.

Materials

Materials commonly used to fabricate gutters and downspouts are aluminum and steel, and occasionally plastic, copper, and wood.

Aluminum gutters are sold in prefabricated sections or can be fabricated on-site in long seamless sections. The sections used in residential work are usually 10 or 20 feet long. They are available with a baked-on enamel finish, usually colored white or brown. Aluminum gutters are more corrosion-resistant than steel, but they are not as strong and they may dent easily. The recommended minimum thickness of aluminum used for gutters is 0.027 inches, and 0.020 inches for downspouts. The most common aluminum gutter shape is the ogee. The common downspout sizes are rectangular, measuring 2" x 3" or 3" x 4".

Steel gutters are sold in prefabricated sections and may be either galvanized or enameled. Steel gutters are usually the least expensive; however, they have a shorter life compared to other materials if they are allowed to rust. Painting galvanized steel is difficult. If a finish other than natural galvanized is desired, it is best to begin with enameled gutters. The recommended minimum thickness of steel used for gutters and downspouts is 26-gauge. Steel gutters are usually ogee or half-round. Steel downspouts can be rectangular or round, and are usually corrugated.

Plastic gutters are sold in prefabricated sections joined with special connectors. The color, usually white or brown, is the same all the way through, and they must not be painted. Long-term exposure to sunlight may cause some types of plastic gutters to become brittle. Plastic expands and contracts with changes in temperature more than any other gutter material. The connectors which permit expansion and contraction of the components are critical features of plastic gutter systems.

Copper gutters are the most expensive of the metal gutters and the most difficult to install. They require soldered joints, whereas steel and aluminum gutters are joined with rivets and seam sealer or with slip connectors. Copper gutters are usually left unpainted because the greenish oxidation has a pleasing appearance. The oxidized coating also serves as a protective coating for the metal. The recommended minimum thickness of copper used for gutters and downspouts is 0.020 inches.

Wood gutters are found on some older homes. Some woods commonly used for gutters include redwood, cedar, cypress, Douglas fir, and pine. They require more frequent maintenance and inspection than other gutter systems. Their value is more historic than useful.

Aluminum and plastic gutters are sometimes installed by homeowners, using components available at hardware stores and home centers. Other gutter systems are usually installed by professionals. Gutters and downspouts are often installed by general carpenters, by siding installers, and by roofers. Systems using copper, or with complex detailing, should be installed by companies having metal-forming equipment.

Styles

Gutters come in many styles—ogee, half-round, rectangular, and built-in. Ogee gutters are the most common because of their attractive appearance and effective rain-carrying capacity. Half-round gutters are usually made of galvanized steel and have an industrial appearance. They are rugged, but their capacity is small. The most common rectangular gutters are plastic. Built-in gutters may be of wood

COUNCIL NOTES

Volume 11, Number 3

© 1990 by The Board of Trustees of the University of Illinois

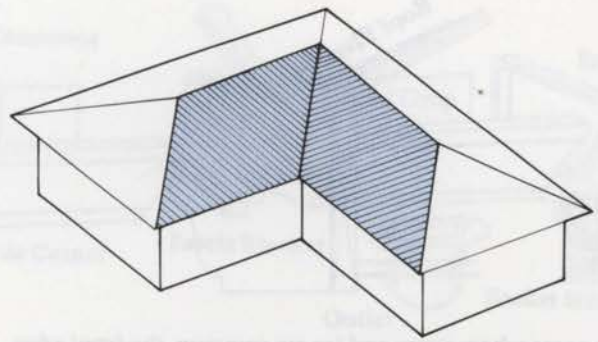
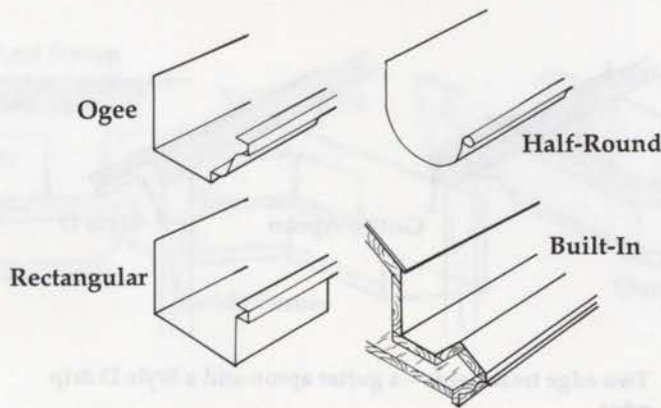
Material in this publication by:

William B. Rose, SHC-BRC

Editor: Henry R. Spies

Illustrations: Selah Peterson

All rights reserved. No part of this publication may be reproduced in any form without permission in writing from the publisher. Published by the Small Homes Council-Building Research Council, University of Illinois at Urbana-Champaign, One East Saint Mary's Road, Champaign, Illinois 61820. This publication is one of a series written for the homeowner. A complete list of publications is available upon request.



Some common gutter styles.

or metal. All built-in gutters must be made on the site, because there are no standard components.

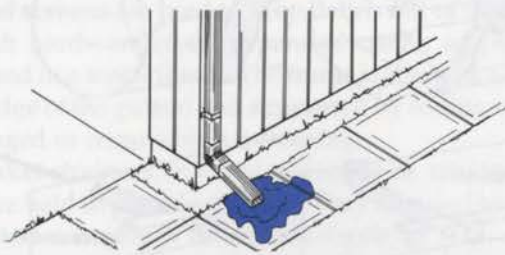
PLANNING

The size of gutters and downspouts is determined by the quantity of water they must carry. Residential gutters are usually five or six inches wide at the top. A five-inch gutter can be used where the distance between downspouts is less than 30 feet, where the roof pitch is 9 in 12 or less, and where the roof area to be drained is less than the gutter length in feet multiplied by 30. Most other cases require six-inch gutters.

Downspouts should be sized to allow one square inch of downspout for each 100 square feet of roof area. Since a 2x3 downspout has six square inches of section area, it can carry the water from 600 square feet of roof area. A 3x4 downspout can drain a 1200-square-foot roof area. It is a good idea to use actual roof area rather than the plan area, because a steeper pitch needs a bigger gutter.

Downspouts are usually placed at each major corner of the house. If the distance between corners is more than 50 feet, or if the gutter length is not a straight run, an intermediate downspout is recommended.

In regions where freezing is common, downspouts should not deposit water near walkways. A common trouble spot is the corner of the garage, where a sidewalk often joins the driveway. If possible, the downspout should be relocated. Otherwise, a properly sloped underground drain may be necessary.



Downspouts which discharge onto walks may create an ice patch during freezing weather. The downspout should be relocated or connected to a drain beneath the sidewalk.

In calculating the area drained by a gutter or downspout, use the actual roof area, not the area of the house under the roof.

If one roof drains onto another roof, the recommended method is to use a section of downspout that lays on the roof to run the water from the upper gutter into the lower one. Any water discharging directly onto the lower roof can erode the roof surface.

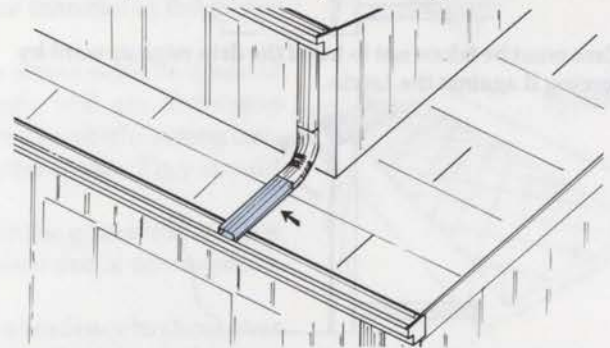
GUTTER INSTALLATION

Gutters may be installed level or sloped toward the downspout. Where appearance is a consideration and building lines must be straight and true, level gutters are preferred. In any case, water should not remain standing in the gutter.

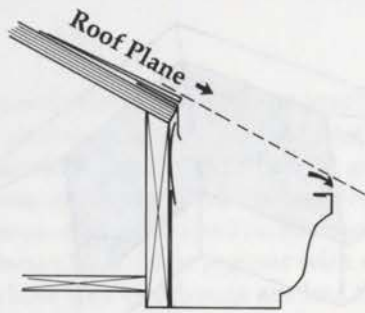
Whether gutters are installed level or pitched, the back edge of the gutter should be placed under the front edge of the metal **gutter apron** or **drip edge**. If the roof does not have a drip edge, one should be installed prior to installing gutters. This will prevent water from getting behind the gutter and rotting the fascia.

If the back edge of the gutter is below the drip edge, a narrow strip of the same metal as the gutter can be placed behind the drip edge and extending into the gutter, so that water runs into the gutter and not behind it.

A gutter apron has a long flange which extends into the gutter. Style D drip edge must be installed carefully, making sure that the bottom flange runs water into the gutter, and that the upper surface is not bent upward by improper nailing.



To drain water from one section of a roof to a lower section, a length of downspout laid on the roof should be used to carry the water to the lower gutter.



In areas where snow and ice are common, the front edge of the gutter should be below the roof plane.

In areas with snow and ice, the gutters should be set low enough that a straightedge laid on the roof extends over the outside edge of the gutter. This is to prevent an ice or snow slide from tearing the gutter loose.

No matter what material is used, gutters expand and contract with changes in temperature. The gutter system must be installed to allow the expansion and contraction of the components.

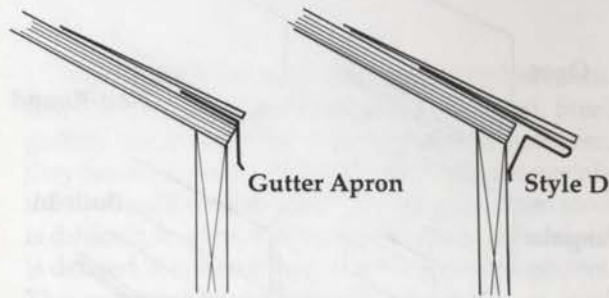
Gutter hangers should be made of the same material as the gutters. There are a variety of types of gutter supports or hangers, including bracket, strap, and spike-and-ferrule. In deciding which method of supporting gutters is most acceptable, consider appearance, expected life, ice loading, size of gutter, material, and expansion. The maximum spacing of supports for aluminum and copper gutters should be 32 inches; for steel gutter, 48 inches. In areas where ice and snow remain for much of the year, gutter supports should be no more than 16 to 24 inches apart. The supports must not only keep the gutter in place under the load of water, snow and ice, but also should keep the gutter from bending inward when ladders are placed against it.



Care must be taken not to bend the drip edge upward by forcing it against the fascia.



If the back of the gutter is below the flange of the drip edge, a strip of coil stock should be inserted behind the flange and extending into the gutter.



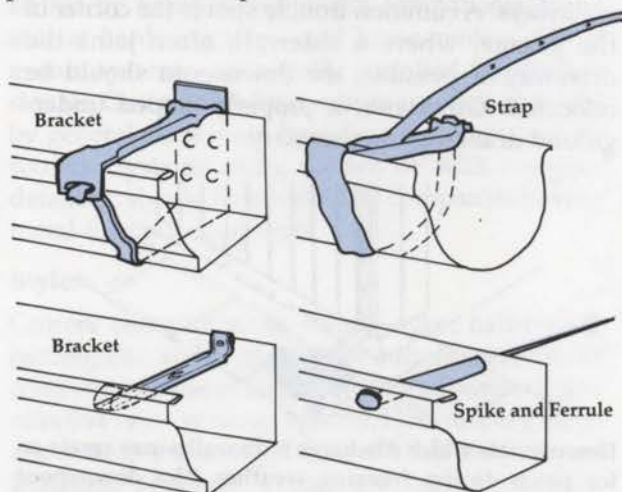
Two edge treatments—a gutter apron and a Style D drip edge.

Brackets (sometimes called cradles) are secured to the fascia board or nailers by two fasteners. Straps are nailed to the roof sheathing, making sure the shingle overlaps the strap. Straps should never be nailed through the upper shingle.

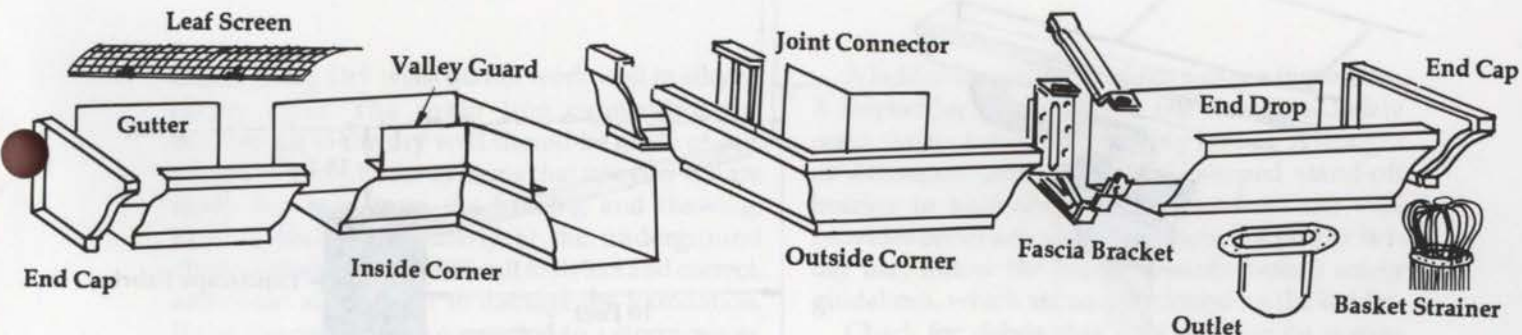
When spike-and-ferrule supports are used, the length of the ferrule should be equal to the inside dimension of the gutter at the bead. The spikes should be 3 inches longer than the ferrules. If the fascia board is less than 2 inches thick, the spikes must be driven into the rafter ends.

Wherever two sections of gutter or accessory are joined, a **connector** is used. It can provide either a fixed joint or an expansion joint. A simple overlap of gutter sections is not acceptable because gutter sections are not designed to be nested. Fixed joints in metal are made using enlarged sections of gutter, using rivets and sealants. Plastic gutter systems may use a fixed joint accessory which is solvent-welded to the gutter on each side.

Expansion joints are commonly used. They allow gutter sections to expand and contract without breaking a fixed joint. The expansion connector in metal systems holds the ends of the gutters in alignment but permits lateral movement. The common plastic connector uses a neoprene seal. Expansion joints should be provided on runs of gutter in excess of 40 feet. They should also be provided where expansion or contraction of the



Typical gutter hangers.



gutter could damage corners. (This is particularly important on houses with hip roofs.)

Location of expansion joints can influence the location of downspouts. Some types of expansion joints act as a dam in the gutter; therefore the gutter sections on either side of the expansion joint must be drained.

Corners for gutter systems are usually manufactured and sold as part of the gutter system. Many corner accessories are designed with an expansion joint connector. The one other common gutter installation accessory is an **end cap**.

DOWNSPOUT INSTALLATION

Downspouts are connected to gutters by **outlets** or **end drops**. Outlets are attached with rivets or sheet metal screws through a hole cut in the gutter. The edge of the opening is usually sealed with a mastic. An end drop is a gutter accessory made up of a length of gutter with an outlet already in place.

Straight downspout material usually comes in 10-foot lengths, which can be cut to the proper length.

If the downspouts deposit water directly into a municipal storm drainage system, sometimes an air pressure relief system known as a leader is installed.

Elbows are used where the downspout turns. Most elbows make a 75° angle and come in styles "A" and "B". The crook of the elbow is along the long side in "A" and the short side in "B". The assembly of elbows and straight material that goes from the gutter outlet to the wall is called the **return**. The angle of the return is usually 75° because of the availability of elbows with that bend.

One end of downspout lengths and elbows is usually crimped so that it fits inside the section below. Sections are usually fastened with pop rivets. Sheet metal screws may rust or corrode, and the points inside can catch and collect debris.

Strap hangers or **hooks** are used to mount downspouts to the house. They should be made of the same material as the downspout. A minimum of two straps should be used on a 10-foot length of downspout.

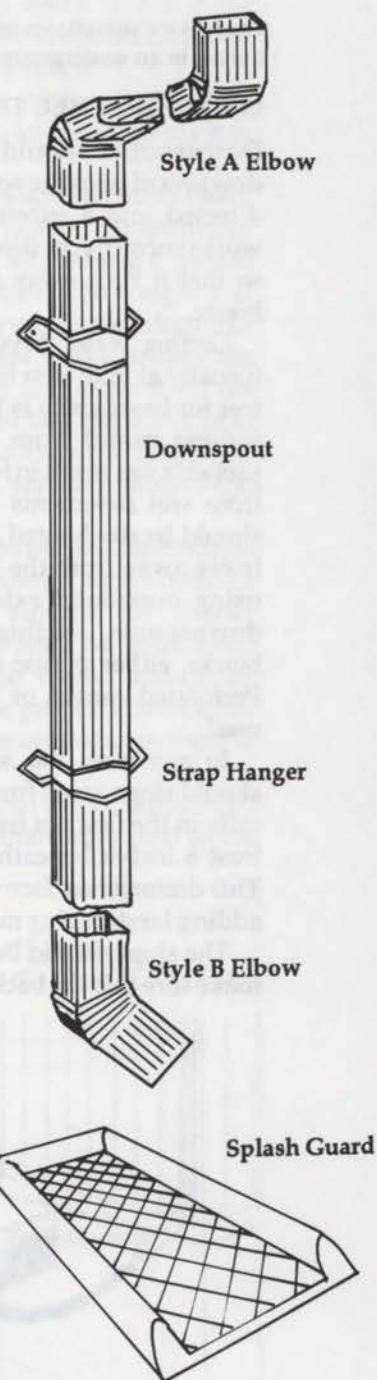
Accessories

Accessories for gutters and downspouts include leaf screens, basket strainers, and gutter baffles. The accessories should be made of the same material as the gutter and downspout.

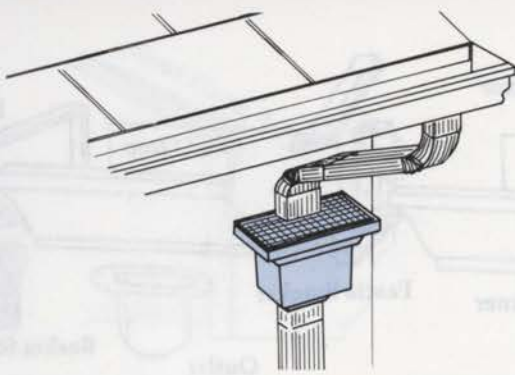
Leaf screens are used to keep debris out of gutters. The screens can be made of 1/4-inch hardware cloth, expanded metal, or plastic mesh, and are sometimes enclosed in a metal frame. The frame is screwed to the gutter bead (the strong outside edge of the gutter) and supported by resting on the gutter spacer. They should be hinged or removable for cleaning.

Basket strainers, made of molded wire, are inserted into the gutter outlet tubes and are held in place by friction. They are used to keep debris out of downspouts. Basket strainers must be cleaned regularly.

Valley guards are used below valleys, where water has a tendency to shoot over the gutter during heavy rainfall. They should extend 2 to 4 inches above the front edge of the gutter. Metal screws or rivets are used to secure the baffle to the gutter bead.



Typical metal gutter system.



Leaders are sometimes used when the downspout is connected to an underground drainage system.

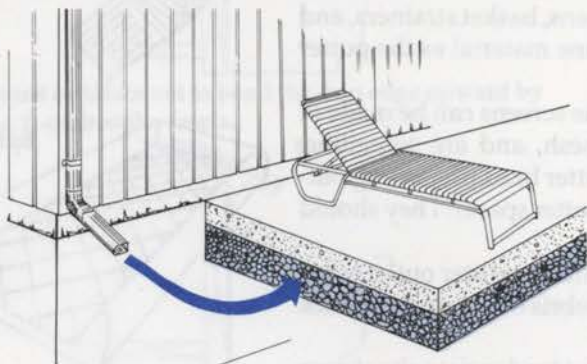
GROUND LEVEL DRAINAGE

Downspouts should never discharge directly downward onto the soil. All the rainwater must be directed into a subsurface drainage system that works correctly, or discharged onto the soil surface so that it runs away from the foundation of the house.

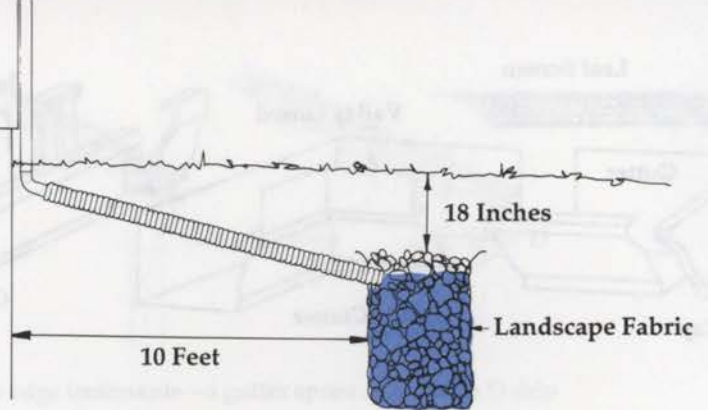
Getting water beyond the foundation backfill (usually at least two feet for crawl spaces and four feet for basements) is the most critical part of controlling runoff from the roof. Failure to do so properly can result in foundation problems ranging from wet basements to structural failure. Water should be discharged at a point where it can flow freely away from the house. This can be done by using horizontal extensions on the end of the downspouts, leading to splash blocks. Splash blocks, either plastic or concrete, reduce erosion. Perforated canvas or plastic sleeves may also be used.

In any case, the soil around the foundation should slope away from the house six inches vertically in the first ten feet (be sure to keep the soil at least 8 inches beneath the bottom of the siding). This drainage surface should be maintained when adding landscaping material or plantings.

The slope should be checked every few years to make sure that the backfill has not settled. Note that



Improper ground-level drainage can permit water to accumulate near the foundation and in the gravel or sand base beneath driveways, patios, and walks.



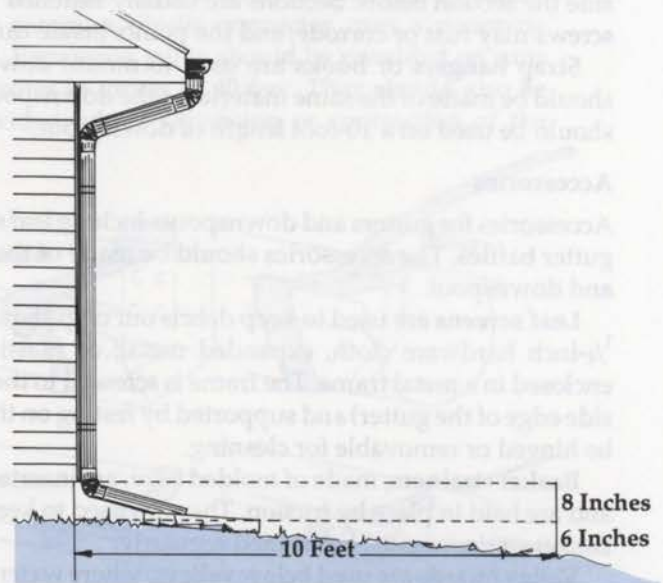
A dry well can be used to dispose of roof runoff in areas with porous soils.

gravel or other ground cover tends to retain water. The slope must be established *beneath* the landscaping materials.

Discharging water where it can flow into the gravel base beneath concrete drives, walks, and patios could lead to problems. It can cause water to flow into the basement or crawl space, and it can cause cracking due to settlement or frost-heaving of the slab. Discharging water onto patios, walks, or driveways may cause icing in the winter. Keep downspout discharge well away from these areas.

Subsurface discharge requires some kind of underground drainage system. This drain must be independent of the house foundation drainage system. Drainage systems for downspouts sometimes drain to a city storm-drain system. Check with city officials to find out if this is allowed.

Downspout drainage systems can lead to a *dry well*. This is a large hole or barrel in the ground filled with rocks and covered with wood or concrete to keep out the soil. The dry well should be located away from the house and only used in soil that



Proper drainage ensures that all water flows away from the foundation. There should be a slope of six inches in ten feet completely around the house.

drains easily. Dry wells do not work well in silty or clayey soils. The drain line connecting the downspout to the dry well should be made of corrugated plastic. Older systems that use clay tile are easily damaged from the freezing and thawing, causing leaks, particularly at the underground elbow. These leaks are difficult to detect and correct, and could allow water to damage the foundation. If the downspouts are connected to a storm sewer, defects in the system can lead to water problems in basements. When replacing or repairing older underground systems, corrugated plastic pipe should be used.

INSPECTION AND MAINTENANCE

Improperly maintained gutters can fail, causing rotting or premature wear of siding and trim, soil erosion, and uncontrolled rainwater seeping through the foundation. A mass of decomposing leaves and seeds can produce metal-eating acids as well as hastening corrosion by holding water for hours or days after a rain. The freeze/thaw cycle of water can stress a gutter system as well. Periodically inspecting the gutter system permits catching and curing gutter problems when they are small, keeping maintenance simple, quick, and inexpensive.

The gutter system should be inspected at least twice a year—spring and fall. More frequent examination is required if the house is located in a heavily wooded area. First, check for separated sections of gutters and downspouts, and for sags in the gutter where sections may be pulling away from the fascia. Look for signs of water on siding, brickwork, and soil, which may indicate leaks or overflow. Also look for water stains on the fascia—an indication that water is seeping behind the gutter.

A ladder should be used for a closer inspection. A stepladder is usually not tall enough to safely reach the roof on even one-story homes. A straight or extension ladder with a U-shaped stand-off bracket to hold the ladder away from the wall provides better access to the gutters. For proper ladder use, follow the ladder manufacturer's safety guidelines, which are usually found on the ladder.

Check for debris that may be clogging gutters and downspouts, sagging gutters, loose supports or connections, and leaks. Also check to see if the water is draining from the downspouts properly and continuing away from the house.

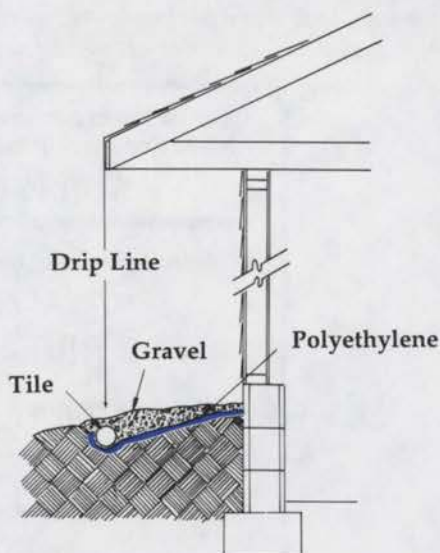
Finally, use a garden hose on the roof to make sure that all the water flows to and through the gutters and downspouts.

Maintenance of the gutter system includes cleaning and repairing the main components. Downspouts can be cleaned by pushing a garden hose down into the outlet tube. The weight and pressure of the water will free most small clogs. For tougher clogs, use a plumber's snake or take the downspout apart in sections and clean it on the ground. Other than leaves and bird nests, the most common clog found in downspouts is a tennis ball. Bird droppings, incidentally, are very corrosive to gutters and downspouts.

The lower ends of downspouts require frequent attention. Poorly fastened elbows and extenders may leak water directly against the house. Downspout extenders must often be re-attached after mowing lawns. Splash blocks should be checked to see that they slope properly. Settlement of the soil near the foundation often causes them to slope backwards.

To repair gutters, the required tools include butyl or silicone caulk to repair small leaks and reseal

For many houses, gutters and downspouts may not be the best method of providing rainwater drainage. Especially in wooded areas, gutters and downspouts tend to clog easily. A practical system is to allow the water to drip from the roof edge (using a metal drip edge or gutter apron to protect the fascia) into an underdrained gravel bed. A drained gravel bed is created by digging a 8-12-inch-deep trench parallel to the foundation and beneath the drip line, lining the bottom and foundation side of the trench with polyethylene, laying a perforated drain tile in the bottom, and backfilling the trench with gravel. Limestone gravel should not be used because it dissolves. River gravel works well and is a common landscape treatment. The tile should empty down slope from the foundation.



joints, a stiff wire brush to clean the area to be repaired, thin material (metal, plastic, or fiberglass mesh) for a patch, roofing cement, a paint scraper or putty knife to apply the comment, gloves, and a bucket for gutter debris. A can of bug-spray may also come in handy for battling wasps or hornets. Gutter patches should be as smooth and flat as possible. A lump in the middle of the gutter will catch leaves and debris, and dam up the water.

Aluminum gutters should not need painting. Galvanized steel gutters may be difficult to paint. New galvanized steel gutters usually have a light coating of oil which must be entirely removed before painting. They may be thoroughly washed before installation, or exposed to the weather, or "pickled" with a very dilute solution of muriatic acid. A special zinc-based primer or a cement-based paint should be used. Before repainting old steel gutters, all rust should be removed with a wire brush.

Repairing wood gutters is difficult. Many wood gutters have been repaired with asphalt or tar compounds in the past. This does not work, and the first step in repair usually involves removal of old asphalt patches. The exposed wood gutter should be inspected for soft, rotted sections, using an icepick or thin screwdriver. If there are only few soft sections, they can be repaired economically using an epoxy consolidant. Extensive repairs usually require either milling new sections of gutter or replacing the entire system with a conventional metal gutter.

COMMON PROBLEMS

A gutter and downspout system should carry all the rainwater from the roof. If it does not, the problem may be caused by leaks, clogging, or the failure of supports.

A more severe and more common problem occurs when the system does not carry rainwater

away from the house foundation. Most problems of flooding, dampness, and mildew growth in basements and crawl spaces can be solved by correcting the drainage system.

If a basement corner is wet or discolored, the downspout in that corner is usually the culprit. Check for leaks, and for discharge too close to the house. If the downspout discharges into a tile, it is possible that the tile is broken or clogged. If it is broken, it should be removed and replaced; if clogged, it should be cleaned out with a snake. If the underground drainage system does not perform properly, it may be better to change to surface drainage.

Leakage through crawl space or basement walls often occurs in areas covered by concrete slabs, such as patios, walkways, and garages. In most of these cases, the backfill has settled beneath the slab, allowing water to run along the foundation beneath the slab to reach the point of entry. The sand or gravel fill beneath these slabs also conducts water readily. Inadequate downspout drainage often feeds these channels.

The most common problem, and one that often causes further damage, is improperly terminated downspouts. This problem can be avoided by locating the downspout where the water can freely flow away from the house. By preventing all of these problems from occurring, and by correcting them when they do occur, bigger and more expensive problems can be avoided.

CONCLUSION

Gutters and downspouts play an important role in maintaining the appearance, structural integrity, and, consequently, value of the home. With proper planning, careful installation, and periodic inspection and maintenance, gutters and downspouts will help protect a house from the potentially damaging effects of water throughout its life.

Council Notes are now being issued on a quarterly basis. For current information on housing topics

SUBSCRIBE NOW!

Special introductory price! 2 years for \$5.00

TO PLACE AN ORDER, CALL

1 - 800 - 336 - 0616

FOR QUESTIONS ABOUT YOUR HOUSE, CALL

1 - 217 - 333 - 1801

9:00-Noon, Central time, Monday through Thursday

Visa and MasterCard accepted

Purchase Orders must include Federal Employers Identification Number