ROOFING MATERIALS

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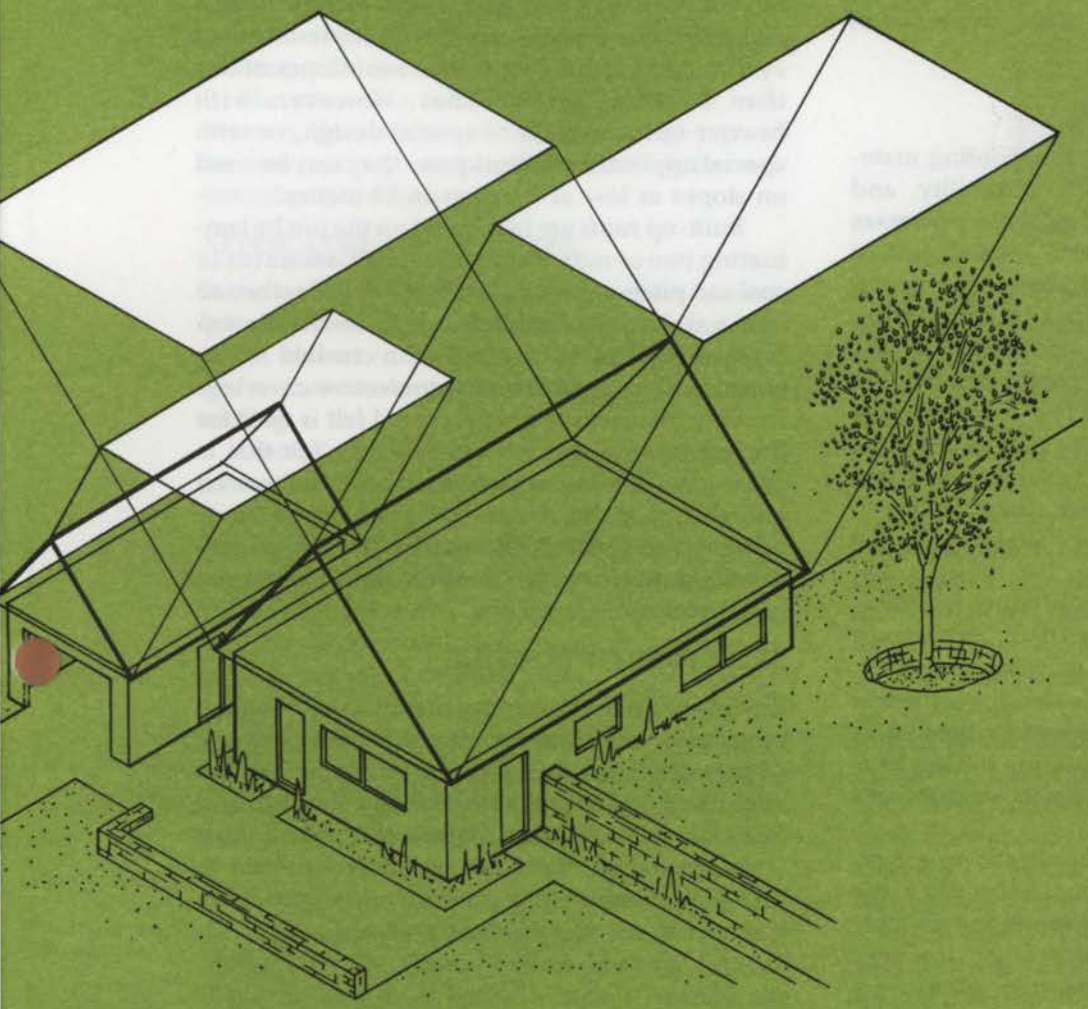

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MATERIAL IN THIS PUBLICATION BY DONALD E. BROTHERSON

Architectural Consultant: Rudard A. Jones, AIA

Editor: Henry R. Spies

Cover: John Roy Illustrations: John B. Sadowski

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SMALL HOMES COUNCIL F12.3

ROOFING MATERIALS

Roofing or roofing materials can be said to have two basic purposes. Primarily, a building is roofed to protect the structure and its contents from the effects of weather. Secondary to protection, the roofing may provide decorative effects. This publication will describe some of the many materials and systems available for residential roofing, typical application details, and some of the problems encountered.

PROPERTIES OF ROOFING

In addition to weather protection, roofing materials must offer fire resistance, durability, and beauty. Each type of roofing material possesses the material, the way the material is used, and, to some extent, the cost of the material.

The standard fire-resistance of roofing materials is established by tests conducted by the ials is established by tests conducted by the Underwriters' Laboratories, Inc. Roofing systems are classified "A," "B," or "C" in descending order according to their resistance to flame applied to the wearing surface, their ability to support combustion, and their suitability for the service intended.

The durability of a roofing product is indicated by the manufacturer, based on experience over a long period of time. In some instances, roofs will be guaranteed or bonded for a specific number of years. The bond, issued by the manufacturer and paid for by the building owner, provides for the replacement of defective materials used in the roof.

Most residential roofing applications are required to impart a certain amount of beauty to the house, or at least not detract from its appearance. This may be accomplished by the use of a very plain, but not unattractive, material, by using a material that will impart color to the roof, or by selecting a material that will give the roof a pleasing texture. The choice will be made by the owner or architect to blend with or complement the rest of the house.

TYPES OF ROOFING

Roofing systems can be grouped into two broad classifications, multiple-unit systems and membranes. Multiple-unit systems depend for the most part on their water-shedding properties to keep the interior dry. Shingles, metal panels, and asbestos-cement sheets are multiple-unit roof systems. On low-sloped roofs, membrane roof systems are used. These systems depend on their watertightness properties rather than their water-shedding ability. Built-up roofs and flat-seam metal roofing are examples of watertight-membrane roofing systems.

Multiple-unit systems are affected to a great extent by the slope of the roof and the exposure of the unit to the weather. For example, a wood shingle 16 inches long can be applied with a 5-inch exposure on a slope of 5 inches in 12 inches, but the exposure must be reduced to less than 4 inches if the roof slope is less than 4 inches in 12 inches. Generally, multiple-unit roof systems should not be used on roof slopes of less than 4 inches in 12 inches. However, with heavier units or units of special design, or with special application techniques, they can be used on slopes as low as 2 inches in 12 inches.

Built-up roofs are fabricated on the job by laminating two or more sheets of asphalt-saturated or coal-tar-pitch-saturated roofing felts together so that a watertight membrane is formed. The top layer of felt may be covered with crushed stone, marble chips, or gravel as a protective covering. In some instances, a heavy, coated felt is used for the top layer and is left smooth, or a felt that is covered with mineral granules similar to those on shingles may be used. Flat-seam metal roofs achieve their watertightness by the use of soldered joints so that water cannot enter below the metal plates.

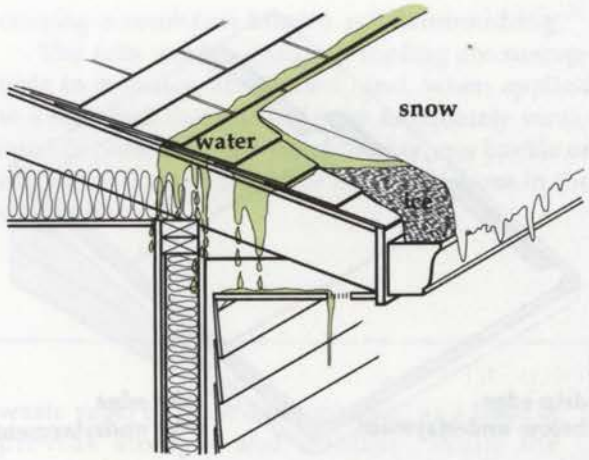
SELECTION OF ROOFING

The selection of the roofing materials and roofing systems is influenced by many factors. The cost of the roof, both initially and for later maintenance, is of primary importance. The durability of the material will affect both maintenance costs and appearance. Short-life materials may have to be replaced before they present leakage problems because of unsatisfactory appearance.

MATERIAL	RELATIVE IN-PLACE COST	RELATIVE DURABILITY	RELATIVE MAINTENANCE
Shingle			
Asphalt	Low	Short-Medium	Occasional
Asbestos-cement	Medium	Medium	Occasional
Slate	Expensive	Long	Minimum
Wood, edge-grain	Medium	Medium	Occasional
Aluminum	Expensive	Long	Minimum
Roll Roofing			
Mineral-surface 19" selvage edge	Lowest	Short	Frequent
Mineral-surface 90# cap sheet	Lowest	Short	Occasional
Mineral-surface pattern-edge roll	Lowest	Short	Occasional
Built-up roof	Medium	Short-Medium	Occasional
Metal Roofing			
Copper	Expensive	Long	Minimum
Terne	Expensive	Long	Minimum
Aluminum	Expensive	Long	Minimum
Clay Tile	Expensive	Long	Occasional

The slope of the roof automatically limits the selection. Low-slope roofs require watertight systems. Steeper roofs can be covered with water-shedding systems. Some materials, such as tile and slate, require heavier roof framing members. Some building codes prohibit the use of wood shingles except when special requirements are met because of the fire hazard they present. Treating wood shingles will somewhat improve their fire-resistance, but they still may not be acceptable in some areas.

The preceding table lists the durability, relative cost, fire ratings, and other factors for some of the more widely used roofing materials for residential construction.



Typical ice dam formation

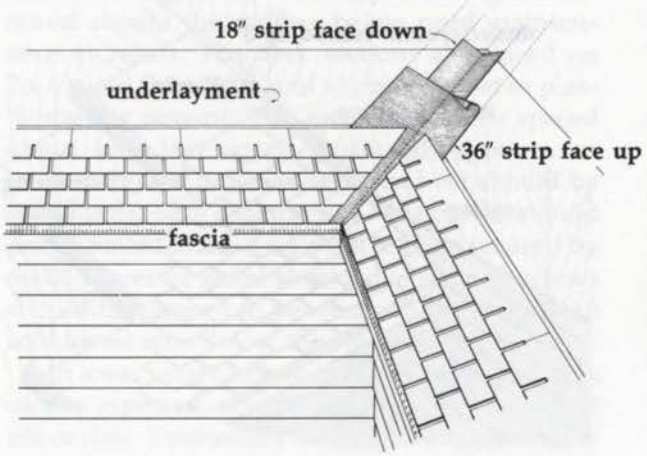
APPLICATION OF ROOFING

Each roofing material or roofing system has certain application details that are peculiar to it alone. However, there are some general requirements that can be applied to almost all forms of roofing.

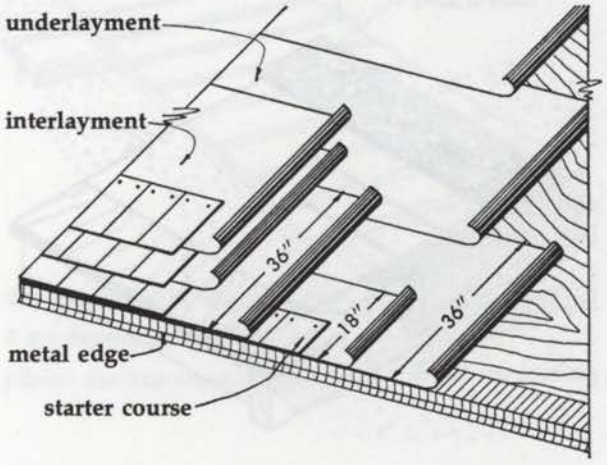
Good flashing details are a requirement of any form of roofing material or system. For multiple-unit types of roofing, this includes metal drip edges, valley flashing, and flashing at the intersections of roofs and vertical walls or chimneys. The membrane-types of roofing require similar flashing techniques. Some typical flashing arrangements are illustrated.

Eaves flashing is always recommended for multiple-unit roofs in areas where freezing of water along the roof edge can occur. Ice formation will cause water to back-up under the shingles and could then drip into the house. Water damage from ice damming usually shows up over windows or where the wall and ceiling join. A double layer of No. 15 felt, laminated with plastic roofing cement, should extend from the edge of the overhang to at least 12 inches beyond the inside face of the exterior walls. Ninety-pound mineral-surfaced roll roofing or 55-pound smooth-surface roll roofing may be used instead of the double layer of No. 15 felts. On slopes less than 3 inches in 12 inches, the eaves flashing should extend at least 24 inches beyond the inside face of the exterior wall.

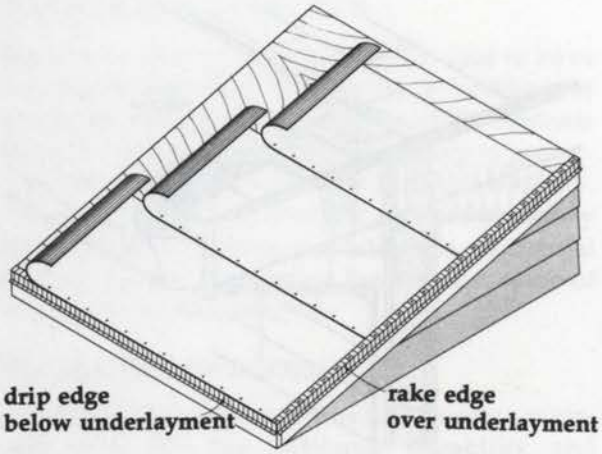
Some materials also require underlayments or interlayments of No. 15 or No. 30 felts. For example, asphalt shingles require a single underlayment when applied over roofs with a slope less than 7 inches in 12 inches. A double underlayment is used when the slope is less than 4 inches in 12 inches. Wood shingles do not need any underlayment; however, with wood shakes (hand-split), an interlayment of an 18-inch wide strip of No. 30 felt between layers of the shakes is used. Slate shingles are laid over a No. 30 felt, and asbestos-cement shingles over a No. 15 or a No. 30 felt. For low-slope applications, asbestos-cement shingles will require 36-inch wide interlayments of No. 15 asphalt-saturated felt spaced so that the felts overlap at least 18 inches.



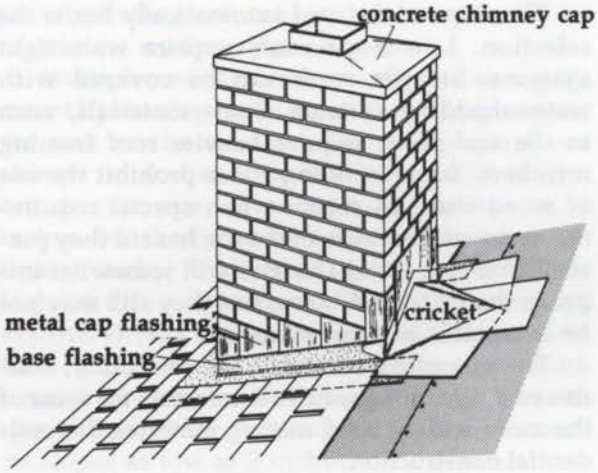
Valley flashing made up of roll roofing



Low-slope application using interlayment felts



Single underlayment with metal drip and rake edge



Chimney flashing detail

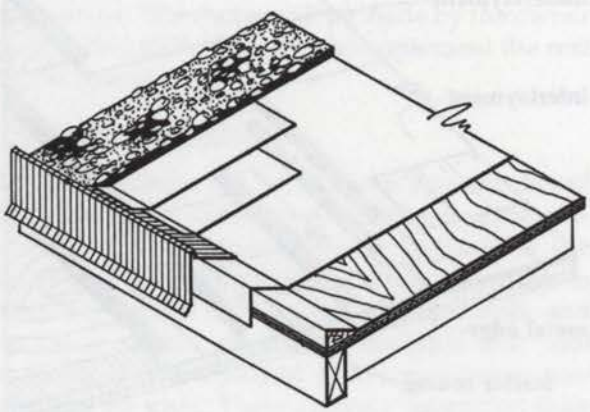
The requirements for underlayments and interlayments vary not only with the material and the slope of the roof but also with the requirements of the local building codes and, if financed with government-insured loans, with the *Minimum Property Standards* of the Federal Housing Administration.

PROBLEMS IN ROOFING

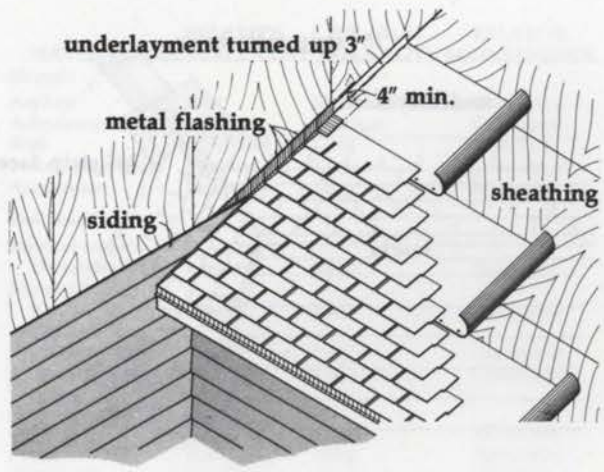
The most troublesome problem in the application of shingle-type roofs is improper nailing. Too often the shingles are nailed too high or with too few nails. When improperly nailed, the shingles lack wind resistance and easily crack or blow off the roof when subjected to high winds.

Faulty flashings are the reason for more leaks than the roofing materials in residential applications. Improperly applied flashings will open and allow water to penetrate the roof. Vulnerable areas are the gravel guards on flat roofs and flashings around chimneys and against vertical walls on roofs of all slopes. Only stepped flashings should be used against vertical walls, as shown in the illustration. The stepped flashings allows water that penetrates to the flashing to run out to the surface of the roofing before it can travel sideways under the roofing. Careful attention to application will prevent these leaks.

Inadequate attic ventilation can also cause problems. Without sufficient attic ventilation, condensation can occur on the underside of the roof sheathing and drip back to the ceiling, making it appear as if the roof is leaking. Distortions of the shingles and rotting of the roof framing or sheathing can also occur if condensation persists. (See Circular F6.2, *Moisture Condensation*, for more information.)



Gravel guard for built-up roof on flat deck



Step-flashing at vertical wall with wood siding

If "green" lumber (lumber that has not been adequately dried) is used for the roof sheathing, it may cause buckling of the roofing material as the lumber dries and shrinks.

The backs of asphalt shingles absorb moisture from rain and snow when stored without weather protection. If these shingles are applied during hot, dry weather, they may distort on the roof, causing a condition known as "fishmouthing."

The felts used in built-up roofing are susceptible to moisture absorption, and, when applied to a roof deck that has not been adequately ventilated or protected by a vapor barrier, can buckle or expand and cause ridges or blisters to form in the roof surface.

ASPHALT SHINGLES

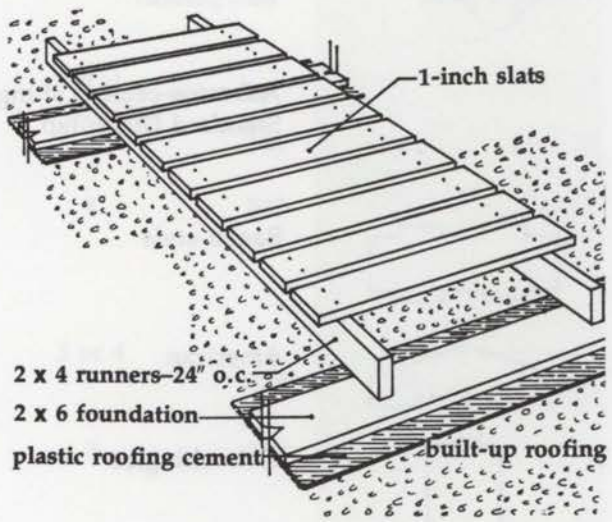
Asphalt shingles have been used for many years because they combine good appearance, relatively long life and low initial cost. They can be used on new construction as well as for re-roofing. When used for re-roofing, under most circumstances, they can be applied directly over the old roofing material. The shingle may be made using either a felt material (usually made of wood pulp, waste paper, and waste rags) or glass fiber material as a base to provide strength and stability. While the organic felt has proven to be dependable and relatively trouble free, the glass fiber can offer additional advantages. The glass fiber is more stable than the felt and is more resistant to fire (Class A). More asphalt is used to coat the fiber glass material, so that the resultant shingle is more durable and should have a longer life.

PORCH AND SUN DECKS

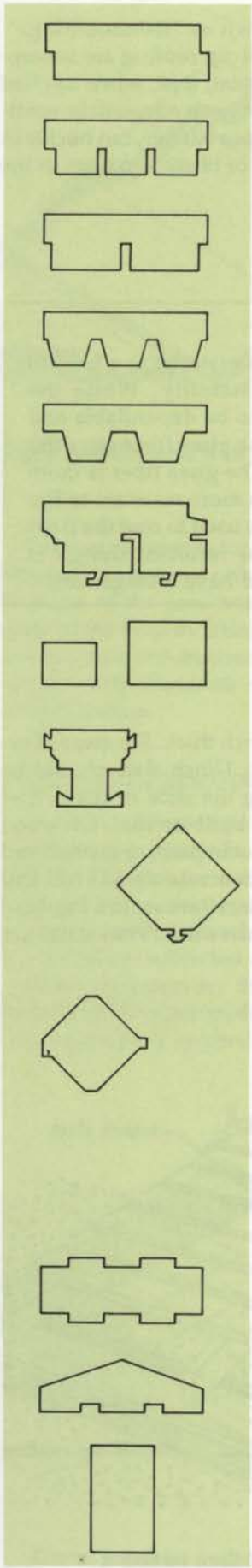
Often the design of a house allows using a flat roof section over a garage, carport, or lower floor area as a sun deck or open porch. Great care must be used when roofing such areas so that a dependable wearing surface will result that will remain watertight under the abuse of furniture and foot traffic.

An easy method of achieving a dependable system is to provide a wood deck (sometimes referred to as "duck boards") over a built-up roof. The deck is made up of one-inch boards (usually 1 x 4's or 1 x 6's) spaced one-fourth to one-half inch apart, supported on 2 x 4's spaced two feet apart. The deck is made up in sections about eight feet long to facilitate easy handling and removal should the roofing below need maintenance or repair. The deck sections are placed on 2 x 6's laid flat on the roof surface and set in plastic roofing cement. The 2 x 6's should be spaced about four feet apart. Redwood, cypress, or lumber treated to resist decay and rot should be used for the deck construction. The panels should not be nailed to the 2 x 6's but may be secured by metal braces or wood chocks. No nails or screws should be allowed to penetrate into the built-up roof membrane below the wood deck.

In areas where severe or heavy usage or traffic can be expected, it is best to consider the use of tile or slate. Promenade tile (unglazed clay tile), or any ceramic tile rated for outdoor use, may be used. Slate is available in various sizes and should be 3/16 to 3/8 of an inch thick. For areas of extreme service, 3/4-inch to 1-inch slate should be used. The deck receiving the slate or tile is first roofed with a 4- or 5-ply built-up roof. On wood decks, the tile or slate is set in pitch or asphalt and the joints grouted. On concrete decks, tile and thick slates (3/4-inch to 1-inch) are set in a Portland cement grout about 3/4-inch thick. Thin slates are set in pitch or asphalt.

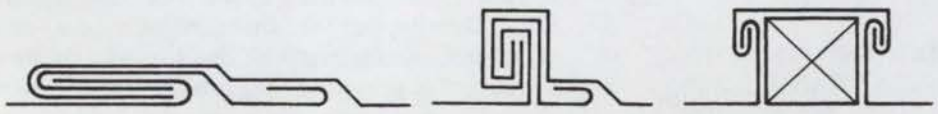


Typical wood deck section



MATERIAL	SIZE	WEIGHT, pounds per 100 sq. ft.	FIRE RATING	MINIMUM SLOPE
Asphalt shingles				
No cutouts	12″ x 36″	240-290	C	4 in 12
3-tab square strip	10″ x 40″	235	C	2 in 12
	12″ x 36″	235-325	C, A	with special precautions
glass fiber, 3-tab	12″ x 36″	215-260	A	
glass fiber, random tabs	14″ x 36″	300	A	
2-tab square strip	15″ x 36″	300	C	
	12″ x 36″	235-325	C, A	
3-tab hexagonal strip	11⅓″ x 36″	195	C	
2-tab hexagonal strip	11⅓″ x 36″	195	C	
Locking strip	18″ x 24″	235	C	
	19½″ x 26½″	235	C	
Individual giant	12″ x 16″	162-325	A, C	
	18⅞″ x 24″	400	A	
Locking	16″ x 16″	180	C	
	18″ x 20″	220	C	
	20″ x 20″	220	C	
Staple-locked	16″ x 16″	180	C	
Asbestos-cement shingles				
Standard Dutch-lap	16″ x 16″	260	B	5 in 12*
Ranch-style	12″ x 24″	235-258	B	
American	14″ x 30″	300-440	B, A	3 in 12
Slate shingles				
	10″ x 6″ to 26″ x 14″	700 to 800		4 in 12

MATERIAL	SIZE	WEIGHT, pounds per 100 sq. ft.	FIRE RATING	MINIMUM SLOPE
Wood shingles				
Std. 3/16" thick	Random width 16"-18"-25" long	200-300		4 in 12
Steel shingles				
(30 gauge)	10" x 60"	88		3 in 12
Aluminum shingles				
(.020"-.030")	10" x 60" 12" x 120"	36-54		3 in 12
Clay tile	SIZE EXPOSURE			
Spanish	8¼" x 10¼"	900	A	4 in 12
Mission	11½" x 11¼" 11½" x 15"	1250	A	
Shingle	8" x 8" 8" x 10" 7" x 6"	800 to 1750	A	
Interlocking	8¼" x 11"	800	A	
Metal roofing				
Copper		(20 oz.)-125 (24 oz.)-150		0 in 12†
Terne 28 ga.		76		
30 ga.		62		
Aluminum 20 ga.		50		



flat-locked seam | standing seam | batten seam

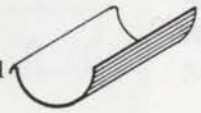
Roll Roofing	TOTAL NO. OF PLIES			
Mineral surface				
19" Selvage dbl. cov. 2 plies No. 15 felt	4	245	C	1 in 12
90# Cap sheet 3 plies No. 15 felt	4	222	C	2 in 12
Built-up roof				
2 or 3 plies No. 15 felt and 1 ply No. 43 felt, gravel or smooth surface	3 or 4	470 to 600	A	0 in 12
4-5 plies No. 15 felt, gravel or slag surfacing	5			

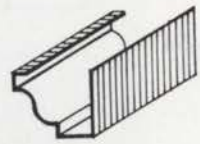
* May be reduced to 2 in 12 with special application technique, including underlayment

† With soldered flat-locked seams

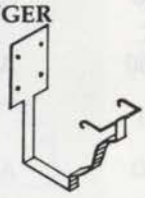
GUTTERS AND DOWNSPOUTS

TYPICAL GUTTERS



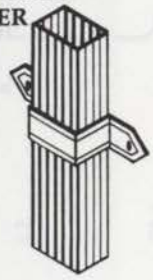


BRACKET HANGER

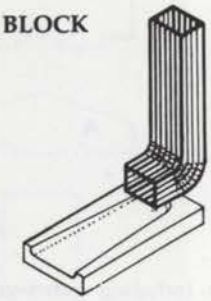


STRAP HANGERS

DOWNSPOUT WITH STRAP HANGER



SPLASH BLOCK



Gutters and downspouts are used to control the disposal of water from roofs. They are necessary where the soil is of such a nature that erosion or expansion of soil will occur if the water is allowed to fall freely from the edge of the roof. They are also needed where roof overhangs are narrow and water flowing over the edge of the roof can cause damage to the exterior walls. When gutters are omitted, the design of the roof must not allow water to drain directly over entrances.

Aluminum, galvanized steel, stainless steel, copper, and zinc-copper alloys are commonly used to fabricate gutters and downspouts. Wood gutters have also been used. When interior downspouts are used, they must be cast iron, DWV plastic, or copper pipe.

Gutters come in a variety of shapes and sizes. The half-round and the "box-type" are the most commonly used. Gutters built into the roof are not recommended. Downspouts are either round or rectangular and are usually corrugated for resistance to bursting from freezing.

The size of the gutter needed is determined by the area of roof to be drained and the intensity of rainfall expected. A rule of thumb for sizing downspouts is to provide one square inch of downspout for each 100 square feet of roof surface. Gutters are selected having approximately the same area as the downspouts, if downspouts are spaced within 40 feet of each other. The width of the gutter should be increased one inch for each additional 20 feet of gutter between downspouts. These ratios may be varied according to rainfall experience.

The gutters are installed sloping slightly to the downspouts by using cast or strap hangers or long spikes with spacers. The hangers should be made of the same material as the gutters. The spacing of the hangers will be governed by the material used. Copper or copper alloy hangers are spaced 30 inches apart; galvanized steel 48 inches; and stainless steel 60 inches apart.

To help prevent water from melting ice or snow from backing up underneath the shingles when the gutters are frozen, the gutters should be installed with the front edge approximately two inches below the roof edge. This will allow the water to overflow the gutter rather than ponding at the roof edge and flowing between shingles.

Downspouts are installed using cast or strap hangers. The downspouts are fastened at the top and bottom, and, in addition, one hanger is provided for each six feet of downspout. The gutter lengths and downspouts are connected to each other by soldering, "pop-rivets," or slip connections. Slip connections allow the sections to move when the lengths expand or contract due to temperature changes. Soldered and riveted sections should be installed so this movement can take place.

The downspouts may be terminated by allowing the water to run out on the ground or by connection to an underground drain. If the water is allowed to flow out on the ground, splash-blocks should be provided to prevent erosion of the soil beneath the downspout. The ground must slope away from the house. If an underground drain is provided, it should be independent of any drainage system provided for the basement or foundation of the building. Never connect downspouts to footing tiles. (See Circular F2.0, *Basements*.)

The drainage system should be provided with wire netting or strainers to prevent debris and leaves from clogging the system. Periodic cleaning and inspection are necessary for proper operation.

Common problems with roof drainage systems are inadequate size of gutters and downspouts, gutters not sloped properly, too few downspouts, hanger or strap spacing too great, and failure to provide expansion joints.