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Asphalt Roofing Manual

The Asphalt Roofing
Manufacturers Association's
Design and Application Methods

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Foreword

From a modest beginning with the marketing of roll roofing in 1893, the asphalt roofing industry has grown steadily through the years to the point where today it is overwhelmingly accepted as the country's leading supplier of roofing products. More than 80 percent of all residential roofing applied in the U.S. is currently produced by the asphalt roofing industry.

The Asphalt Roofing Manufacturers Association (ARMA) is the voice of the asphalt roofing industry. Founded in 1915, the Association has an impressive record of member service through public information programs, research, educational training, code development and many other activities.

This manual has been prepared by ARMA as a part of its commitment to the asphalt roofing industry and is intended to be a reference book of application techniques that have a history of successful roof performance. It does not, however, contain the only possible methods with which one may obtain satisfactory roof performance.

The manual is used for a variety of purposes. Its primary purpose is to provide practical information to those who sell and install asphalt roofing so that the ultimate purchasers of these products may obtain maximum performance for their roofing dollars.

To those engaged in the distribution of asphalt roofing products, it serves as a dependable reference guide to good roofing practice in the selection and application of asphalt roofing.

To those engaged in the installation of the product, it serves as a text covering time-proven principles in the application of both asphalt shingles and roll roofing.

To those engaged in the teaching of good roofing application techniques, it serves as an effective educational tool.

While this manual represents the industry's views on recommended application procedures, individual asphalt roofing manufacturers may have specific instructions for specific products. Therefore, it is important to review all instructions contained on the product's packaging before application begins.

The asphalt roofing products described and illustrated on the following pages are all shown with English dimensions. Asphalt strip shingles, for example, are typically 12" wide and 36" long with a 5" exposure. Metric-sized shingles, which have slightly larger dimensions, are being used in the United States market as well. In addition, there are a number of new shingles with unusual sizes.

While the general installation procedures for these shingles may be similar to those for standard-size shingles, whenever new sizes of shingles are encountered, manufacturers instructions may vary. Check the packaging carefully for specific application instructions or consult the individual manufacturer.

It is also important to note that the Asphalt Roofing Manufacturers Association does not test, certify or approve products used in connection with asphalt roofing systems. The recommendations contained in this manual reflect application techniques and materials that have been used successfully over many years. If you are considering the use of application techniques and/or deck materials which are not covered in this manual, it is advised that you consult the appropriate asphalt roofing manufacturer for proper guidance.

Finally, grateful acknowledgment is made to the members of the Residential Roofing Committee of the Asphalt Roofing Manufacturers Association, who are responsible for developing the recommendations contained in this manual and keeping them up-to-date. Their many years of combined roofing experience and knowledge as well as their extensive assistance and contributions during the preparation of this manual have proven to be invaluable.

Typical Asphalt Roofing Products and Their Advantages

Asphalt roofing products are classified under three broad groups: shingles, roll roofing and underlayment.

Shingles and roll roofing are outer roof coverings, meaning they are exposed to the weather and are designed to withstand the elements. Underlayments are inner roof coverings which provide necessary protection beneath the exposed roofing materials.

As outer roof coverings, asphalt shingles and roll roofing, organic or fiberglass based, contain three basic components that provide the protection/long-term durability associated with asphalt roofing products. These components are:

- **A base material made of an organic felt or fiberglass mat**
  Serves as the matrix which supports the other components and gives the product the strength to withstand manufacturing, handling, installation and service conditions.
- **A specially-formulated asphalt coating**
  Provides the long-term ability to resist weathering and remain stable under severe service temperature extremes.
- **A surfacing of weather resistant mineral granules**
  Shields the asphalt coating against the sun's rays, adds color to the product and provides fire resistance.

Shingles

Asphalt shingles are the most common roofing material used in the United States today. They are manufactured as strip shingles, laminated (multi-thickness shingles), interlocking shingles and large individual shingles in a variety of weights and colors.

Strip shingles are typically rectangular, and may have as many as five cutouts along the long dimension. Cutouts separate the shingle's tabs, which are exposed to the weather, and give the roof the appearance of being comprised of a larger number of individual units. Strip shingles are also manufactured without cutouts to produce a much different appearance. The three-tab shingle is the most common type of strip shingle.

Table I: Typical asphalt shingles

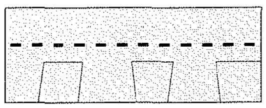
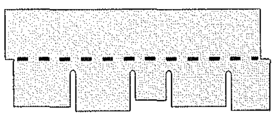
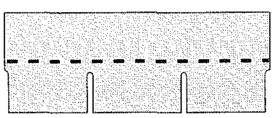
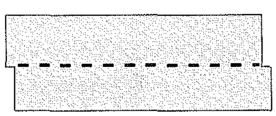
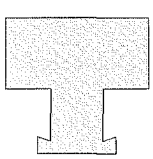
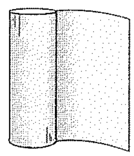
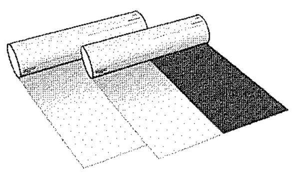
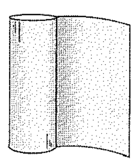
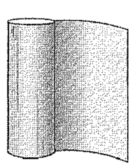
Product	Configuration	Appx. shipping weight per square (lbs.)	Shingles per square	Bundles per square	Width (in.)	Length (in.)	Exposure (in.)	ASTM fire and wind ratings
Laminated self-sealing random tab shingle 	Various edge, surface texture and application treatments	240-360	64-90	3-5	$11\frac{1}{2}$ - $14\frac{1}{4}$	36-40	4-$6\frac{1}{8}$	Class A or C fire rating. Many wind resistant.
Multi-tab self-sealing square tab strip shingle 	Various edge, surface texture and application treatments	240-300	65-80	3-4	12-17	36-40	4-8	Class A or C fire rating. Many wind resistant.
Multi-tab self-sealing square tab strip shingle 	Three-tab or four-tab	200-300	48-80	3-4	12- $13\frac{1}{4}$	36-40	5-$5\frac{5}{8}$	Class A or C fire rating. All wind resistant.
No-cutout self-sealing square tab strip shingle 	Various edge and surface texture treatments	200-300	65-81	3-4	12- $13\frac{1}{4}$	36-40	5-$5\frac{5}{8}$	Class A or C fire rating. All wind resistant.
Individual interlocking shingle (basic design) 	Several design variations	180-250	72-120	3-4	18- $22\frac{1}{4}$	20- $22\frac{1}{2}$	n/a	Class A or C fire rating. Many wind resistant.

Table 2: Typical asphalt rolls								
Product	**Appx. shipping weight per roll (lbs.)**	**Appx. shipping weight per square (lbs.)**	**Squares per pkg.**	**Width (in.)**	**Length (ft.)**	**Selvage (in.)**	**Exposure (in.)**	**ASTM fire and wind ratings**
Mineral surface roll 	75-90	75-90	1	36-39$^{3}/_{4}$	32.7-38	2-4	32-34	Some Class C
Mineral surface roll (double coverage) 	55-70	110-140	$^{1}/_{2}$	36-39$^{3}/_{4}$	32.7-36	19	17	Some Class C
Smooth surface roll 	50-86	40-65	1-2	36-39$^{3}/_{4}$	32.7-72	2-4	34-37$^{3}/_{4}$	None
Non-perforated felt underlayment 	24-60	6-30	2-8	36	72-288	2-19	17-34	May be a component in a comlete fire-rated system. Check with manufacturer for details.
Self-adhered eave and flashing membrane 	35-82	33-40	1-2$^{1}/_{4}$	36	36-75	2-6	34	May be a component in a comlete fire-rated system. Check with manufacturer for details.

Shingles

(continued)

Most of the shingles are available with strips or spots of a factory-applied, self-sealing adhesive which is a thermoplastic material activated by the heat of the sun after the shingle is on the roof. Exposure to the sun's heat bonds each shingle securely to the one below for greater wind resistance. During the spring, summer and fall, this self-sealing action usually takes place within a few days of the installation. In winter, the self-sealing action varies depending upon the geographic location, roof slope and orientation of the house on the site.

Weather-resistant mineral granules applied to the top surface of strip shingles during the manufacturing process make possible the widest range of colors available in roofing materials.

The tabs of a strip shingle may be cut straight or cut offset to obtain a straight or staggered buttline respectively. They also may be embossed or built up from a number of laminates of base material to give a three-dimensional effect. Each of these shingle characteristics — staggered buttlines, embossing and lamination — can be combined in various ways to create textures on the finished roof surface that resemble tile, wood, or slate.

Interlocking shingles are also available and are designed to provide immediate resistance to strong winds. These shingles come in various shapes and with various types of locking designs that provide a mechanical interlock on the roof.

Large individual shingles are generally rectangular or hexagonal in shape. (See Chapter 10.)

These typical forms of strip and interlocking shingles are illustrated, with specifications, in Table 1 on page 2.

Roll Roofing

As the name implies, roll roofing is manufactured, packaged and shipped in rolls. It comes in a wide range of weights and measures (see Table 2 on page 3). Roll roofing products are produced with either a *smooth surface* or a *mineral surface*, the latter of which contains mineral granules that are embedded in the top side of the sheet.

Some mineral-surface roll roofings are manufactured with a granule-free selvage edge that indicates the amount each succeeding course should overlap the preceding course. Others have laying lines on the granule surface to indicate lap location. The manufacturer's recommendations with respect to the top, side and end laps should be followed. The amount of overlap determines how much of the material is exposed to the weather and the extent of "coverage" to the roof surface; i.e., whether most of the surface has a single or a double layer of roll roofing.

In addition to its use as a roof covering, roll roofing is also important as a flashing material. Typical roll roofing products are shown in Table 2.

Saturated Felts/ Underlayments

These products consist of a dry felt which may be impregnated or coated with an asphalt saturant. They are used primarily as underlayment for asphalt shingles, roll roofing and other types of roofing materials. These types of felts are also useful as sheathing paper.

Saturated felts are manufactured in a variety of weights for use as underlayment or heavy-duty underlayment.

Self-Adhered Eave and Flashing Membranes

Self-adhered eave and flashing membranes are polymer modified bituminous sheet membranes which can be used in place of saturated felt underlayments in critical roof areas to resist water leakage due to the backup of water from ice dams, melting snow or wind. Critical areas where self-adhered underlayments are commonly used include: along the eaves where there is the possibility of ice dams forming, rake edges, valleys, around skylights and chimneys, dormers and in low slope areas. Self-adhered underlayment membranes are installed by removing the release liner and applying the membrane to the structural roof deck.

Self-adhered eave and flashing membranes can also be useful in warmer climates where a similar backup of water can occur from an accumulation of pine needles, leaves and other debris.

If a self-adhered eave and flashing membrane is used, refer to the application instructions under "Eaves Flashing for Ice Dam Protection" on page 43 and consult the manufacturer for specific application instructions.

The Advantages of Asphalt Products

The dominant leadership of asphalt roofing products through the years has not evolved as a matter of chance. It is based on proven product performance that goes beyond the basic roofing requirement of providing a covering that shields the building's inhabitants from the weather.

The product characteristics that have earned asphalt roofing its leading position include all of the following:

- **Weather resistance**

  As a result of constant research and testing of the product and its application, asphalt roofing resists sunlight, heat, cold, water and ice.

The Advantages of Asphalt Products
(continued)

Fire resistance
Asphalt roofing products are manufactured to comply with the American Society for Testing and Materials (ASTM) standards for fire resistance (ASTM E 108). The importance of fire-resistant roofs cannot be overemphasized because roofs are particularly vulnerable to fire from external sources such as sparks or brands emitted by nearby fire.

Wind resistance
Asphalt roofing products complying with the Underwriters Laboratories (UL), ASTM or other wind-resistant standards have been laboratory tested to withstand winds up to gale force. The wind-resistant feature, originally developed for use only in high wind areas, is now available throughout the U.S.

Economy
Efficient, high-volume production plus relatively low cost of application result in economies that are difficult for competing roofing materials to match. Moderate installed costs combined with long service life give asphalt roofing products a very low annual or life-cycle cost.

Ease of application
Asphalt roofing is considered to be the easiest of all standard roofing materials to apply.

Adaptability
Because of their flexibility and strength, asphalt roofing products can be applied on a wide variety of roof styles.

Aesthetics
Asphalt roofing is available in many appealing colors, shapes and dimensional depths that provide bold roof appearances. The wide range of asphalt roofing products introduced in recent years offer much greater flexibility in choosing colors for a building's exterior than is available with most other type of roofing material.

Style suitability
Asphalt roofing is completely "at home" with most architectural styles, whether contemporary, modern or traditional.

Low maintenance
Properly chosen and applied, asphalt roofing products require little or no regular upkeep and are easily repaired if damaged.

How Asphalt Roofing Products are Manufactured

chapter II
How Asphalt Roofing Products Are Manufactured

The manufacture of asphalt roofing begins with the processing of raw materials into the principal product components, namely, the asphalt saturants and coatings and the organic or fiberglass base materials. These components are then combined during the production process. Other production line operations apply mineral surfacings, cut, trim and package. The in-process results are constantly monitored and inspected to ensure the quality of the finished product.

Asphalt

Asphalt is a unique building material which occurs both naturally and as a by-product of crude oil refining. Because the chemical composition of crude oils differs from source to source, the physical properties of asphalts derived from various crudes also differ. However, these properties can be tailored by further processing to fit the application for which the asphalt will be used. Softening point, ductility, flash point and viscosity–temperature relationship are only a few of the properties of asphalt that are important in the fabrication of roofing products.

Asphalt intended for roofing must be tailored to perform two separate functions. The first is to saturate the organic base material. This requires that the asphalt be very fluid at processing temperatures so it can totally impregnate the base material. The second is to coat the saturated base material and serve as the medium for adhering mineral surfacing to the roofing. In the manufacture of roofing on a fiberglass base material, the saturation step is eliminated.

When it arrives from the refinery, asphalt (referred to as "flux") is soft and sticky. Saturant and coating asphalts are both made from the same flux by an oxidizing process known as "blowing." During this process, air is bubbled through hot flux. Heat and oxygen cause chemical reactions which change the characteristics of the asphalt. Catalysts may be used to produce saturants or coatings which have slightly different properties. The blowing process is continually monitored and is completed when the desired properties are produced. The asphalt is then pumped to a storage tank prior to delivery to the roofing production line.

Asphalt
(continued)

As a final step, coating asphalts are reinforced with a mineral stabilizer such as finely ground limestone, slate, flyash, or traprock. The stabilizer increases the coating asphalt's resistance to fire and weathering and adds durability.

Organic and Fiberglass Bases

For years the traditional reinforcement sheet for asphalt roofing was a modified paper known as "felt." Thicker and more absorbent than conventional paper, felt is composed primarily of cellulose fibers derived from recycled waste paper and/or wood fiber.

To manufacture a cellulose or organic felt, the various raw materials are first fed into beaters and other types of paper processing equipment to produce a pulp (a suspension of fibers in water). This pulp is then formed into the felt which is dried, slit to the desired width while being wound into "jumbo" rolls measuring approximately 6' in diameter.

Inspectors constantly check the quality of the felt by measuring such properties as moisture content, weight, tensile strength, tear resistance and absorbency. Keeping these properties within specification is vital to the felt's ability to function properly.

The period since the late 1950's has seen the introduction of inorganic base materials as an alternate to those made with organic fibers. Instead of cellulose fibers, inorganic bases consist entirely of glass fibers of various lengths and orientations. Since the late 1970's, improved technology has helped establish the fiberglass mat as the major substrate in the marketplace.

The weight and thickness of a fiberglass mat is usually much less than that of an organic felt.

The fiberglass mat is typically formed by a wet process that uses glass filaments oriented in a controlled manner to obtain the desired properties of the finished mat.

In the wet process, chopped strands are dispersed in water and formed into a mat. The water is removed by a vacuum and a binder is applied to the mat. The binder is then cured and the mat is dried.

Finally, the mat is slit to the desired width while being wound into jumbo rolls for conversion to asphalt roofing products.

Quality control is as important to fiberglass mats as it is to organic felts. Uniform weight and fiber distribution must be checked continually as must tensile strength and proper tear resistance to prevent breaks on the production line.

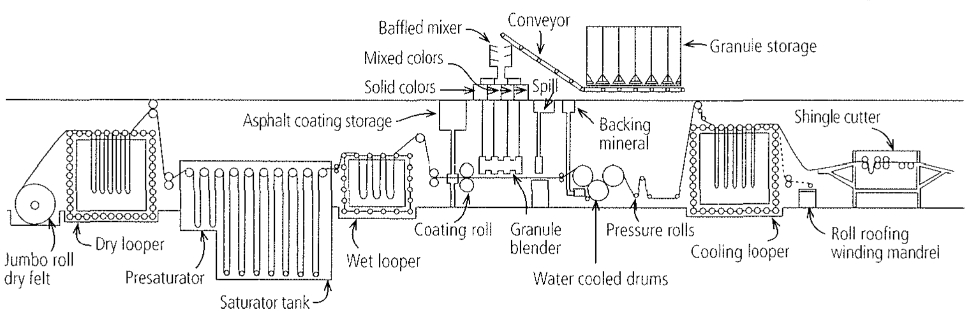
The Manufacturing Process

The manufacture of asphalt roofing products is a continuous process performed on a roofing machine that begins at one end with a roll of base material and concludes at the other with the finished product. This sequence of operations builds the product up in stages, adding materials along the way and monitoring their application. Figure 1 illustrates the sequence of events. The roofing machine components and principal steps that comprise the manufacturing process include the following:

Dry Looper

To begin the process, a roll of base material is placed on a reel and unwound onto a dry looper or accumulator. The looper acts as a reservoir of base material and allows for continuous operation of the roofing machine. Because of the accumulator, it is not necessary to shut down the entire production line when a new roll of base material is being added to the line.

Figure 1
Representative flow diagram of roofing machine



Saturator

If an organic felt is being run, it must first be saturated with asphalt. To accomplish this, the felt enters a presaturation chamber where hot asphalt is sprayed onto one side to drive out any moisture that might be trapped in the fibers. The dry felt then goes into a saturator tank where it is immersed in hot saturant to impregnate the fibers and fill the voids between them. In some plants, the spray chamber is eliminated and the felts are impregnated through a series of immersions in the saturator tank.

Wet Looper

The organic felt leaves the saturator tank with an excess of saturant on its surface and enters a wet looper where the asphalt is drawn into the material as it cools to obtain an even higher degree of saturation.

[Note]
In the manufacture of fiberglass based shingles, processing through the saturator tank and wet looper is not necessary.

The Manufacturing Process
(continued)

Coater

Next, the felt moves to a coater where a mineral-stabilized coating asphalt is applied to the top and bottom surfaces simultaneously. The clearance between the coating rolls regulates the amount of asphalt applied. Most roofing machines are equipped with automatic scales that keep the product within weight specifications.

If a fiberglass mat is being run, the coating asphalt both coats the fibers and fills the voids between them. As a result, fiberglass mats do not have to pass through the saturator or wet looper.

Mineral Surfacing

After the asphalt coating is applied, both sides of the sheet receive a mineral coating. If smooth-surface roll roofing is being manufactured, both sides are covered with talc, mica or similar minerals of fine consistency. The sheet passes over a series of rollers to adhere the fine particles to the asphalt and to cool the material.

If granule surfaced products are being manufactured, the top surface of the sheet is covered with mineral granules of specified color. Sand, talc or mica is applied to the back surface. A series of cooling drums and rollers under controlled pressure embed the granules in the coating asphalt.

Finish or Cooling Looper

At this point, the sheet is accumulated on a finish looper. Here the material is allowed to cool to a point where it can be cut and packaged.

Shingle Cutter

As shingles are being manufactured, the material moves from the finish looper onto a shingle cutting machine which cuts the sheet from the back or smooth side. The shingles are mechanically separated and stacked to form a bundle of the appropriate weight and quantity. They are then moved to packaging equipment where the bundles are wrapped, labeled and palletized before being stored in the warehouse or shipped.

Roll Roofing Winder

As roll roofing is being manufactured, the material moves from the finish looper onto a winding mandrel which measures the length of the sheet as it turns. When the proper length of the roll has been wound, the sheet is cut. The roll then has a wrapper applied. It is then removed from the mandrel and palletized before warehousing or shipping.

Quality Control

Throughout the manufacturing process, the roofing material is continually inspected to ensure that the product conforms to specifications. Organic felts are monitored to determine the quantity of saturant being absorbed, the efficiency of saturation, as well as thickness, distribution and uniformity of the coating asphalt is measured. Asphalt fiberglass shingles are monitored for coating uniformity, distribution and thickness. Tests are made to determine whether the mineral-granule surfacing is distributed uniformly and properly embedded in the coating. Finally, inspections are made to confirm weight, count, size, coloring and other characteristics of the finished product as it leaves the roofing machine.

Storage

An important aspect of maintaining the quality of the product that emerges from the manufacturing line is proper storage. Whether at a manufacturing plant, a distributor's warehouse or a job site, certain procedures must be followed to ensure that the finished product will be in prime condition when applied onto a roof. In every case, the manufacturer's recommendations for storage should be observed.

As a general rule, store shingle bundles in a cool, dry place in stacks not more than 4' high. If higher stacking is necessary use racks or bins that prevent the weight of the bundles on the upper pallets from bearing down on the bundles below.

Systematically rotate all stock so that the material that has been stored the longest will be the first to be moved out (i.e., first in, first out).

Store roll material upright. If several tiers must be stored on top of one another, place plywood sheets between the tiers to prevent damage to the ends of the rolls and to stabilize the stacks.

Arrange stock so that there is ample space for forklifts and other handling equipment to operate without bumping into and damaging materials in the stacks.

It is not recommended to store asphalt roofing products outdoors for extended periods of time. If it must be done, place the materials on a raised platform or pallets so that they are not in contact with the ground. In addition, cover the roofing materials with vented plastic sheets or breathable tarpaulins to protect them from rain or snow. Ventilate the protective covering to allow air to circulate. Never store shingles in the hot sun.

Although asphalt has been used successfully as a building material for many centuries, modern asphalt roofing products are the results of relatively recent research and development efforts by individual manufacturers and the industry as a whole.

Research

Manufacturers maintain their own laboratories and research staffs to provide expertise and service in areas such as raw materials, manufacturing processes and product performance.

Research involving areas of industry wide interest has been continuously sponsored by ARMA for over 50 years. This work has been conducted by government and private research organizations as well as member companies.

Some of the valuable information these research activities have produced include:

- The effects of mineral stabilizers in coating asphalts.
- The interaction of various fibers on the formation and properties of roofing felts.
- Basic studies of asphalt chemistry to improve the durability of roofing products.
- A rapid method of detecting changes in the crude oil used to produce asphalt.
- Procedures and equipment to rapidly predict the weathering life of asphalt and the finished roofing products.

The acceptance and established reputation of asphalt roofing prove how well these individual and industry-wide research activities have worked for the ultimate benefit of the end user.

Fire Resistance

Any number of sources, including chimney sparks, a brush fire or airborne burning brands ejected from a nearby burning building, can ignite a roof covered with a flammable material. Fire resistance, therefore, is an important safety consideration and the reason why many local building codes require that roofing materials conform to certain standards in this respect.

Asphalt roofing manufacturers voluntarily submit their materials to independent testing laboratories that test them in accordance with established standards. The most widely accepted standard for fire resistance in building materials is ASTM E 108 "Standard Test Methods for Fire Tests of Roof Coverings."

If the material meets the standard, the product may carry the testing laboratory's label indicating its class of fire resistance in accordance with the named standard. These classes are listed below.

- Class A — severe exposure to fire
- Class B — moderate exposure to fire
- Class C — light exposure to fire

The material's performance is judged on the basis of three tests that determine its resistance to intermittent flame, flame spread and ignition from burning brands. To earn the appropriate Class

A, Class B or Class C rating, the roof covering material must not, at any time during or after each of the tests:

- Blow or fall off the deck as flaming or glowing brands.
- Break, slide, crack or warp to expose the roof deck.
- Allow the roof deck to fall away as glowing particles.
- Allow sustained flaming of the underside of the roof deck.

Most asphalt fiberglass roofing products manufactured in the U.S. carry a Class A rating and most organic roofing products carry the Class C rating. The label is evidence that the material will provide the level of fire resistance for which it is rated. Thus, manufacturers usually display the label prominently on their packages to indicate the rating of their product. These standards are backed by regular visits by independent third-party testing labs to manufacturing plants as well as periodic testing of product samples to see that they continue to meet the fire resistance specifications.

Wind Resistance

Most manufacturers certify asphalt shingles to wind performance test standards on a continual basis through independent third-party testing laboratories. In this standard test, which has been used for many years, shingles are applied to a roof deck according to the manufacturer's specifications, sealed under controlled conditions and subjected to a continuous wind velocity of 60 mph for two hours. The asphalt shingles are monitored continuously throughout the test.

To pass this test and obtain a wind resistant rating, no single tab may lift during the entire two hours. Shingles that have passed the standard wind performance requirements, such as ASTM D 3161 "Standard Test Method of Wind Resistance for Asphalt Shingles (Fan Induced Method)" or a similar standard, will be identified by the labels from the testing laboratory with which they comply. ARMA suggests that users of asphalt shingles rely on the good wind performance history of asphalt shingles tested to ASTM D 3161 or a similar standard.

In recent years, ARMA has sponsored an extensive wind research program to investigate a more "real world" approach to measuring the performance of asphalt shingles in different climatic regions and conditions. The program, conducted at Colorado State University (CSU), utilized a Meteorological Wind Tunnel to evaluate both a small-scale (1:25) house model and test deck with full scale asphalt shingles. A full-scale house was utilized to correlate the wind tunnel work.

ARMA believes the wind performance program will provide the necessary scientific data and solutions related to "real world" asphalt shingle performance. Other competitive industry groups have not completed a similar performance assessment program.

Wind Resistance

(continued)

The performance of asphalt shingles in high wind areas is of great importance to the product manufacturers. Asphalt shingles continue to be the product line leading the roofing industry in product performance, test methodology and related research.

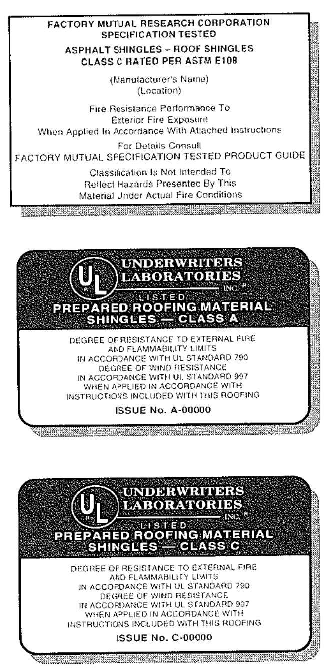
Testing Laboratories

A detailed listing of third party independent testing laboratories can be obtained from the American Society for Testing and Materials or the American Council of Independent Laboratories, Inc.

American Council of Independent Laboratories, Inc.
1725 K Street, N.W.
Washington, DC 20006

Directory of Testing Laboratories: STP 33 E–ASTM
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
ATTN: Customer Service Department
(610) 832-9500

Figure 2
Typical labels from independent testing laboratories



Design Considerations

Ventilation and Moisture Control

Although not usually recognized as a major design consideration, the proper ventilation of attic areas is an essential factor in gaining the maximum service life out of the building materials used in the roof assembly, in addition to improving heating and cooling costs. Overlooking this consideration may result in:

- Premature failure of the roofing including blistering.
- Buckling of the roofing due to deck movement.
- Rotting of wood members.
- Moisture accumulation in insulation.
- Ice dam formations in cold climates.

Ventilation Effects on Heating and Cooling Costs

During the winter months, moisture control is a major concern. Heavier insulation and tighter construction techniques help seal the side walls more effectively against air migration. At the same time, large volumes of occupancy generated water vapor are pushed toward the much drier outside air. This can result in the blistering of shingles. Vapor retarders will reduce the flow, but not stop it.

Condensation results when water vapor comes in contact with a cold surface such as the underside of a roof deck. Condensed water vapor can soak insulation and affect its performance. It can also cause wood to rot, plaster to crack, and paint to peel. Proper attic ventilation can guide water vapor from the attic space before condensation can occur and cause trouble. Ice dams are formed by the cyclical thawing of snow over the warmed portions of the roof and subsequent refreezing at the cold eave. Proper ventilation can reduce the overall temperature of the roof deck, minimizing the thawing of snow and ice on the surface of the roof.

With proper ventilation, air will circulate freely under the roof deck and carry away water vapor before it can condense. One of the best methods is a combination of continuous eaves and ridge vents which together provide a uniform natural draft ventilation from the bottom to the top of the attic space. Louver and vent openings should not be covered during the winter. Eaves or soffit vents should not be blocked by insulation. Structures with bath and kitchen vents which are vented directly to the attic space require additional ventilation to remove excess water vapor.

Ventilation Effects on Heating and Cooling Costs
(continued)

During the summer months, radiant heat from the sun can cause high roof deck temperatures. Gradually, the entire attic space is heated, and, in turn, the entire dwelling feels the effect of a hot roof. This heat buildup can be short-circuited by ventilating the underside of the roof deck. Research has reinforced the idea that prolonged exposure to high heat levels will accelerate aging and shorten the service life of asphalt roofing products. Having a properly ventilated flow-through air space between the roof deck and a radiant barrier or layers of insulation will offer protection against heat buildups.

The minimum specifications of one square foot net free ventilating area for every 150 $ft.^2$ of attic floor space is a good starting point. It should be pointed out, though, that those specifications were written well before the concern for energy conservation and the subsequent trend towards tighter house construction. They may not be sufficient for every structure. The manufacturers of ventilating systems and vapor retarders should be consulted for proper use of their products.

Ventilation Hints and Practices

[Note]
Do not vent exhaust air directly into roof cavity or attic.

① Minimum net free ventilation area of 1 $ft.^2$ for each 150 $ft.^2$ of ceiling area is recommended. When vents are located at eaves or soffits and near the roof's peak or along the ridge for maximum air flow, free vent area may be reduced (minimum 1 $ft.^2$ for 300 $ft.^2$). Wire screening can reduce ventilation by half so allow for this during design.

② Vent exhaust air from kitchens and bathrooms to outdoors with vent pipes that run through the roof cavity or attic to roof ventilators.

③ Provide for free airflow between framing and/or under roof sheathing at eaves to insure that ceiling or roof insulation does not block ventilation paths. For vaulted or cathedral roof construction provide a free ventilation path from the eave vent to the ridge vent, between all rafters, below the shingle decking and above the insulation.

Slope

Of all the factors to consider in choosing an asphalt roofing product, one of the most critical is the slope of the roof because it affects the surface drainage of water and thereby dictates the limits within which shingles or roll roofing may be used. Free drainage is essential to the overall performance of all asphalt roof coverings and can make the difference between a weather-tight roof and one that leaks.

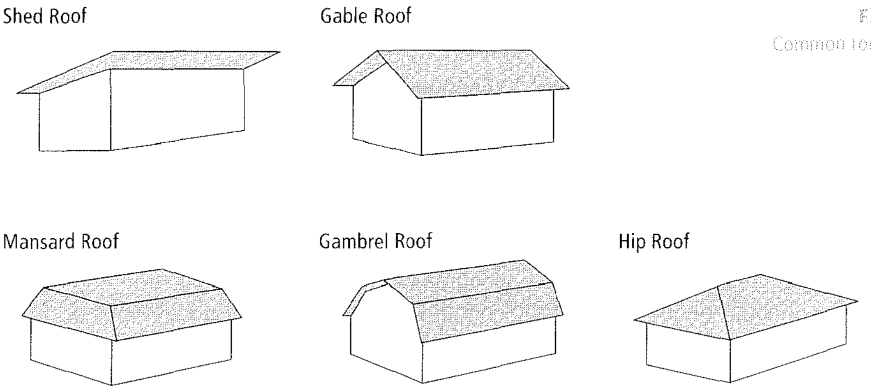


Figure 3
Common roof styles

The slope of a roof is determined by its style. A number of common styles are illustrated in Figure 3.

In general, asphalt shingles may be used on roof slopes from 4" – 21" per foot using standard application methods. For roofs having a slope greater than 21" per foot, special steep slope application procedures must be followed (see page 65). Asphalt shingles may be used on slopes from 2" per foot to 3.9" per foot if special low slope application procedures are followed (see page 63).

The minimum slope on which roll roofing may be used depends on the application method and the type of roll roofing. Roll roofing may generally be used on roof slopes down to 2" per foot.

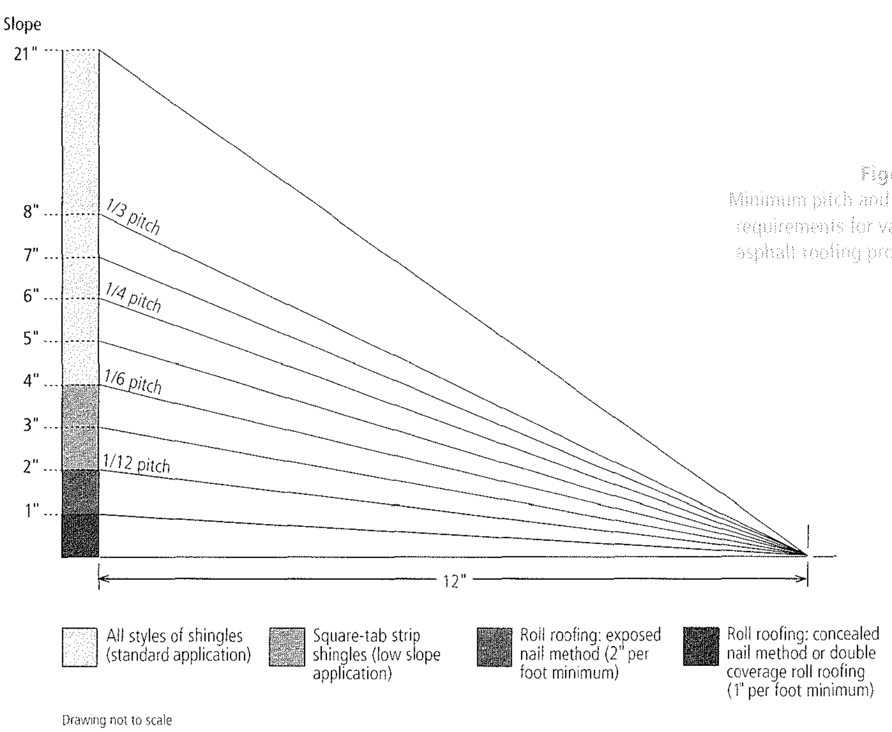


Figure 4
Minimum pitch and slope requirements for various asphalt roofing products

Slope
(continued)

Double coverage roll roofing, which typically provides a top lap of 19", may be used on slopes down to 1" per foot. In general, roll roofings should not be used on slopes less than 1" per foot unless specified by the manufacturer.

Slope limitations for asphalt roofing materials are summarized in Figure 4 on the previous page.

Deck Materials

[Note]
The type, grade, thickness and installation of materials used for decks should conform to the requirements of building codes.

The deck should be built with third-party approval agency structural rated sheathing panels or the equivalent thereof of non-veneer structural panels. Historically, asphalt shingles have performed well over nominal ½" plywood decking. All wood products must be properly conditioned to be at moisture equilibrium. Failure to use properly conditioned deck materials can result in deck movement, which will distort or damage the overlying roofing materials. Distortion or damage of roofing resulting from deck movement is not a manufacturing defect of the roofing product. To avoid or reduce the appearance of buckles or distortions caused by old lumber roof decks, apply a minimum layer of ¼" sheathing prior to shingle application.

Individual roofing manufacturers may or may not recommend all approval agency rated deck materials. Check with the roofing manufacturer for specific recommendations.

Direct Application of Asphalt Shingles Over Insulation or Radiant Barrier Decks

With today's high cost of energy and the emphasis placed on energy conservation, many homeowners, when reroofing, are applying insulation over the existing roof and then applying asphalt shingles directly over insulation or a radiant barrier.

Asphalt roofing manufacturers recommend against this practice for the following reasons:

① Shingles may be damaged or punctured when nailed to a nonrigid surface.

② The nail-holding power of shingles applied directly over insulation may not be adequate, leaving shingles prone to wind damage.

③ Due to the insulation and radiant barriers preventing heat dissipation underneath the shingles, heat buildup may accelerate the weathering and reduce the life of the roof.

④ Fire and wind ratings on asphalt shingles may be affected. Individual systems should be checked with the manufacturer for the appropriate rating.

⑤ Proper ventilation underneath the roof deck is impossible to accomplish when applying shingles directly over insulation or radiant barriers.

Remember, for insulated decks and radiant barriers it is recommended that a flow-through ventilated air space be provided between the top of the insulation and the nailable deck to assist in vapor and heat dissipation.

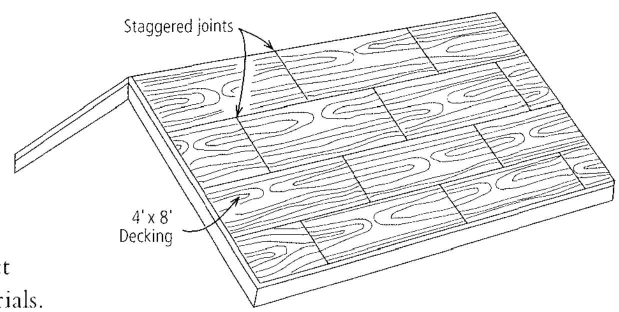
Deck Preparation

A number of roofing problems may result from defects in the underlying roof structure. Therefore, it is important that the materials supporting the roof deck be properly installed.

The underlying structure should provide a rigid deck surface. It should not sag, shift or deflect under the weight of roofing materials, the workers installing the materials or the snow loads the roof may have to support. An unstable structure could lead to movement that will affect the integrity of the roofing and flashing.

Warping as well as other problems may result even with well seasoned lumber if the attic space under the roof deck or the spaces between the rafters and beams in a cathedral ceiling or mansard roof are not properly ventilated. Poor ventilation can result in an accumulation of moisture that eventually condenses on the underside of the roof deck.

Figure 5
Typical Roof Deck



Inspect the lumber before installation. Do not use any boards that are badly warped, have loose knots or have excessively resinous areas. Wood resin may chemically affect asphalt roofing materials.

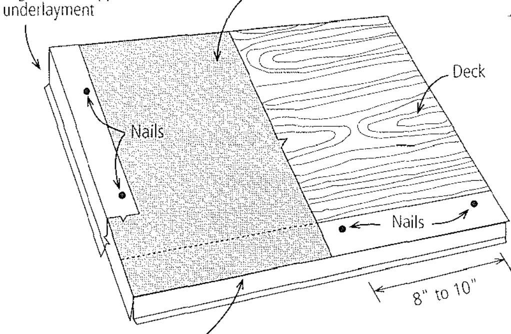
Always check for a flat nailing surface before installing deck panels. Follow the deck manufacturer's attachment instructions carefully when installing each panel. For more information, contact APA - The Engineered Wood Association at P.O. Box 11700, Tacoma, WA 98411, (206) 565-6600.

If the sheathing is already in place, check it for excessively resinous areas and loose knots. Cover each of these areas with sheet metal patches and/or underlayment before the roofing is applied.

Drip Edges

Drip edges provide efficient water shedding at the rakes and eaves and protect the underlying wood from rotting. Drip edges should be made of a corrosion-resistant material that extends approximately 3" back from the roof edges and bends downward over them.

Figure 6
Application of drip edge at rake and eaves



Apply the drip edge underneath the underlayment along the eaves and over the underlayment on the rakes. Figure 6 details the placement and fastening of drip edges in combination with underlayments. The use of a drip edge is strongly recommended.

Roofing Nails

It is recommended by ARMA that properly driven and applied roofing nails are utilized as the preferred nailing system for asphalt shingles.

Nails

Nails should have a minimum nominal shank diameter of 12 gauge, 0.105", and a minimum head diameter of ⅜". Nails will have smooth shanks (except for "gripper marks" sometimes located just below the head) although nails with shank deformations such as "barbs" may be used.

Corrosion Resistance

Galvanizing by various processes is the typical means of achieving corrosion resistance. Aluminum roofing nails do not require additional coatings for corrosion resistance. Steel nails should be protected.

Nail Length

Nails should be long enough to penetrate ¾" into the roof deck. Where the deck is less than ¾" thick, the nail should be long enough to penetrate fully and extend at least ⅛" through the roof deck.

In determining the nail length consideration should be given to the number of layers of shingles, shingle thickness(es), underlayment and flashings (eaves, sidewall and valley, etc.).

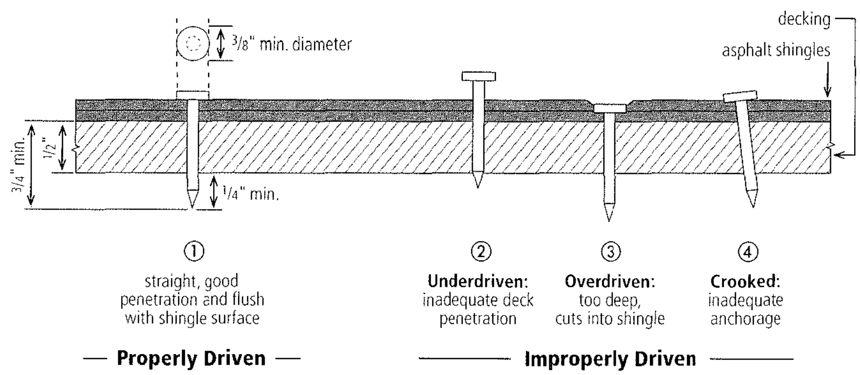
In some cases the underside of the deck is exposed to view. In this case, using nails of the recommended length may result in the nail points penetrating through the deck and being exposed to view.

Nailing

Proper nailing is essential to good performance. To ensure proper nailing during shingle application:

- Use the correct type, size and grade of nail as specified in the shingle manufacturer's application instructions.
- Use corrosion resistant nails.
- Use the recommended number of nails per shingle.
- Position the nails as required by the shingle manufacturer.
- Align the shingles properly before nailing to avoid exposing nails in the course below.
- Drive the nails straight and flush with the shingle surface.
- Do not break the shingle surface with the nail head.
- Do not drive nails into knot holes or cracks in the roof deck.
- Repair faulty nailing immediately.
- Follow manufacturer's instructions concerning special nailing procedures for steep slopes, high wind areas, etc..

Figure 7
Proper and improper application of roofing nails



If a nail does not penetrate the deck properly and cannot be tapped down to be properly driven, remove the nail, repair the hole in the shingle with asphalt plastic cement and place another nail nearby. If necessary, replace the entire shingle. (See Figure 7.)

Quantity and Placement of Nails

The following practices reflect the general recommendations of most shingle manufacturers. However, the specific recommendations of the shingle manufacturer, as printed on each shingle wrapper, should be followed when applying shingles.

Nails must not be driven into or above the factory-applied adhesives. Align each shingle carefully. Whenever possible, make sure that no cutout or end joint is less than 2" from a nail in an underlying course. Start nailing from the end nearest the shingle just laid and proceed across. This will help prevent buckling. To help prevent distortion, do not attempt to realign a shingle by shifting the free end after two nails are in place. Drive nails straight so that the edge of the nail head does not cut into the shingle. Nail heads should be driven flush with the shingle surface, not sunk into it. Figure 7 illustrates examples of proper and improper nailing.

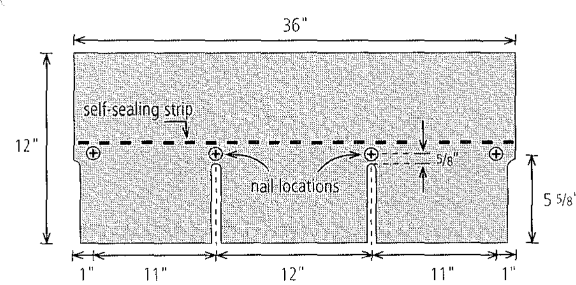
Nailing Method (Normal Weather Conditions)

In areas with normal weather conditions, the following application methods should be utilized:

(A) Placement of nails on three-tab strip shingles

Each of these shingles, both the conventional 36" long shingles and the "metric" shingles, should be fastened with four nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line ⅝" above the top of the cutouts, 1" in from each end, and centered over each cutout. The center of the nail should be applied on center at all four nail locations. (See Figure 8.)

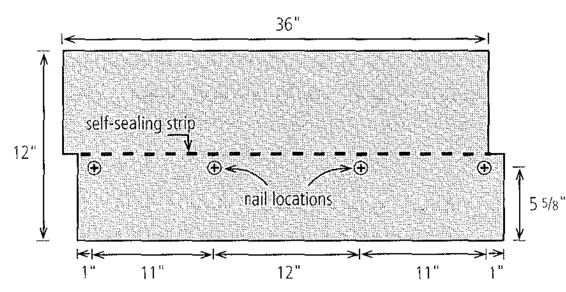
Figure 8
Nail locations for three-tab strip shingle



(B) Placement of nails on no-cutout strip shingles

Each of these shingles, both the conventional 36" long shingles and the "metric" shingles, should be fastened with four nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line 5⅝" (6⅛" for metric) above the butt edge and located 1" and 12" (1" and 13" for metric) from each

Figure 9
Nail locations for no-cutout strip shingle



end. The center of the nail should be applied on center at all four nail locations. (See Figure 9.)

Nailing Method (High Wind Regions)

For areas considered to be high wind regions by local building code authorities, the following six nail method should be considered:

Ⓐ Placement of nails on three-tab strip shingles

Both the conventional 36" long shingles and the "metric" shingles should be fastened with six nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line ⅝" above the top of the cutouts, 1" in from each end, and 1" to the left and right of center of each cutout. The center of the nail should be applied on center at all six nail locations. (See Figure 10.)

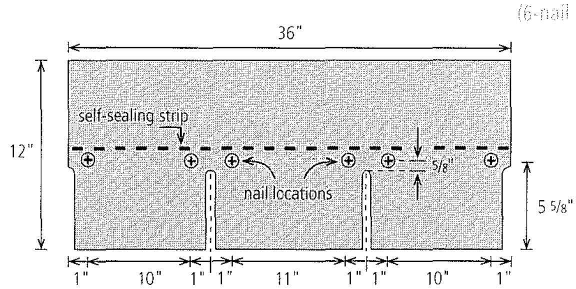


Figure 10
Nail locations for three-tab strip shingle (6-nail method)

Ⓑ Placement of nails on no-cutout strip shingles

Both the conventional 36" long shingles and the "metric" shingles should be fastened with six nails. When the shingles are applied with an exposure of 5" (5⅝" for metric), the nail locations should be on a line 5⅝" (6⅛" for metric) above the butt edge and located 1", 11" and 13" (1", 12" and 14" for metric) from each end. The center of the nail should be applied on center at all six nail locations. (See Figure 11.)

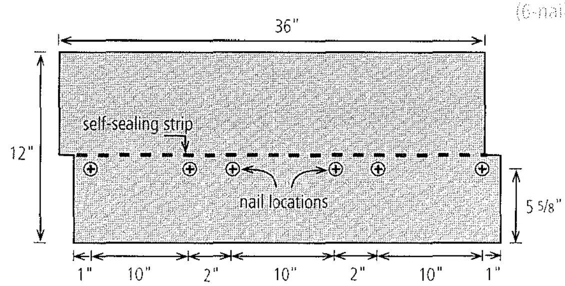


Figure 11
Nail locations for no-cutout strip shingle (6-nail method)

Storage

Asphalt roofing materials will give less than adequate performance if allowed to become waterlogged before installation. As a result, make provisions at the job site for protecting them against the weather. Because of the importance of proper storage, techniques discussed in Chapter 2 are reemphasized here:

Storage

(continued)

- Never stack shingle bundles more than 4' high.
- Never store asphalt roofing products in direct contact with the ground. Place them on a raised flat platform.
- Never leave the materials exposed to the weather. Cover them with tarpaulins or plastic bags that are vented to provide free air circulation.
- Never store shingles in extreme cold. Store in a warm place prior to application.
- Care must be taken when working with asphalt products that have been stored in temperature below 40°F, so as to avoid potential cracking of the product.

Selection of the Right Asphalt Roofing Product

There is an asphalt roofing product to meet every roofing requirement, but no one product is necessarily the best for every job. On many jobs, several alternatives may exist.

The "right" product should be chosen based on a number of considerations including local wind conditions, fire ratings and aesthetics.

Coverage and Exposure

Exposure is defined as the portion of roofing material which is exposed to the weather after the roofing is installed. The exposure for various asphalt roofing products is specified by the manufacturer. Never vary the shingle exposure between courses by more than ±⅛", as this deviation may negatively affect roof performance. Shingle sides should be butted together to maintain adequate shingle coverage. Typical exposures were given in Tables 1 and 2 in Chapter 1. The exposure of the shingle creates the appearance intended by the shingle design (i.e., wood shakes, slate, etc.).

Coverage is an indication of the amount of weather protection the asphalt roofing provides. Depending on the number of plies or layers of material that lie between the exposed surface of the roofing and the deck, the material is designated single, double or triple coverage. Where the number of plies varies, coverage is usually considered to be that which exists over most of the roof area. For example, where no significant roof area has less than two thicknesses of material, the installation would be considered double coverage.

Asphalt roll roofing are generally considered single coverage products because they provide a single layer of material over the greater part of the roof area. An exception is roll roofing applied with a 19" overlap and 17" exposure which is considered a double coverage material. Asphalt strip shingles are also considered double coverage materials because their top lap is 2" or more greater than their exposure.

Fire Resistance

Flying, burning embers from a nearby fire could reach your roof, ignite the roofing material and spread, causing extensive damage to your entire house. For this reason, it is important to know the fire resistance features of the roofing materials you choose.

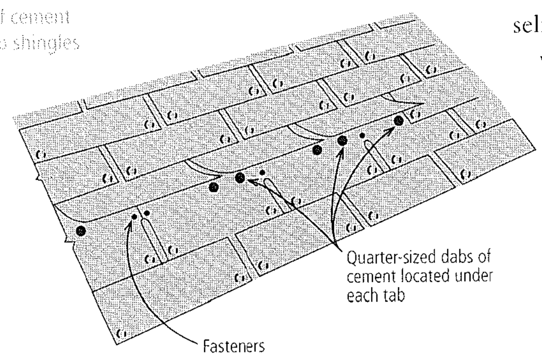
Today, asphalt shingles carry an independent laboratory's label indicating that the roofing material used has passed certain tests for fire resistance (see page 12).

Wind Protection

Wind storms are a major concern to users and manufacturers of various types of shingles. Recognizing the need for a more comprehensive method of testing shingles for wind resistance, the Asphalt Roofing Manufacturers Association (ARMA) has developed a process that combines bond strength testing, wind tunnel studies and research on full scale houses under "real life" situations.

Upon sealing, wind-resistant shingles provide additional protection for roofs in high wind areas. Several types of asphalt shingles offer this feature including those manufactured specifically for the purpose with either a factory-applied adhesive or integral locking tab. Regardless of the type of shingle used for wind protection, it should comply with current standards for wind resistance.

Figure 12
Application of cement under free-tab shingles



The factory-applied adhesive on self-sealing shingles is activated by heat from the sun. In winter, bonding can take longer than during warmer seasons of the year depending upon the geographic location, roof slope and direction that the structure faces.

During the colder months following installation, it is not uncommon for asphalt shingles to have a tendency to curl at the edges. This phenomena known as "cold curl" is due to contraction of the asphalt coating which causes the edges of the shingles to lift. Cold curl is a normal occurrence and should correct itself when the roof warms up either by sunlight or by an increase in the ambient temperature.

If hand sealing is indicated for any reason, asphalt plastic cement, commonly referred to as flashing cement, may be used (conforming to ASTM D 4586).

Two spots of this cement about the size of a quarter are placed under each tab. One spot may be placed one 1" to 2" from each end of tab and near the bottom, but not so close to the bottom that it is squeezed out from the tab as the tab is pressed into the cement. Consult the individual shingle manufacturer's recommendations for specific hand tabbing instructions. (See Figure 12.)

Aesthetics

One of the most significant developments in asphalt roofing shingles has been the aesthetic freedom they now offer. There is a range of color available to match anyone's imagination in designing the exterior of a home. For example, in addition to such standard colors as white, black and the light pastels, asphalt roofing products are available in numerous blends or mixes of red, brown, grey and green. If the intent is to relate the building to a natural environment, these latter colors should be considered. They may also be employed to complement and reinforce the natural colors of other building elements such as brick or stone walls and wood siding.

Roof color can also be utilized in the design of a home to obtain certain psychological effects. For example, a small house may be given added dimension by a light colored roof that will direct the eye upward and help create a sense of airiness. Dark colors on a tall or steeply-sloped building will help create the opposite effect, bringing the structure down in scale visually.

In addition to color, the use of asphalt shingles can also contribute to the overall architectural effect of a building. Many of these shingles offer the "look" of wood but with the long-term wear and fire safety of asphalt shingles. Others offer the "look" of slate or tile. All create interesting visual effects of light and shadow over the roof expanse because of their three-dimensional appearance.

Color Shading

As the roof is viewed from different angles or under different light conditions, certain areas sometimes appear darker or lighter. This difference in appearance is commonly called shading.

Shading usually results from slight variations in texture which occur during normal shingle production. The variation necessary to cause shading with black or other dark colors is so slight that it cannot be detected during the manufacturing process.

When light is reflected from these roofs the appearance will vary as the viewer walks past the building. The impact will depend on the position of the sun and the overall light intensity. When the sun is directly overhead, the shading may disappear.

Color Shading

(continued)

Shading is most frequently observed in the case of black or dark color shingles. Since only a small part of the light is reflected from a dark roof, very slight differences in texture of the shingles may cause this problem.

In the case of white and light colored shingles, the total amount of light reflected is considerably greater and observable differences are diminished.

Blends made of a variety of colors actually tend to camouflage this effect and observable differences are further reduced. Lighter colored blends reduce this effect more than darker blends. Over time, weathering will reduce the noticeable effects of shading.

The appearance of shading can also be caused by:

Backing Material

The backing material used to keep the shingles from sticking together in the bundle can rub off or transfer to the surfacing material. Natural weathering from rains and sunlight should eventually remove this loose backing.

Storage

Shingles that have been stacked too high or have been stored over long periods of time can develop minor staining from the lighter oils contained in the asphalt coating. Natural weathering will usually eliminate this.

Application

Manufacturers recommend that shingles be applied by starting at the bottom of the roof, working across and up. This will blend shingles from one bundle into the next and minimize any shade variation from one bundle to the next.

① Some shading should be accepted as normal in the application of asphalt roofing.

② Allow sufficient time to wash off loose backing material and to permit any oil stains to weather out.

③ Use blends. With blends, shading is less apparent.

④ Insist upon recommended application methods.

Shading is an optical problem and in no way affects the durability of asphalt roofings. Some shading is normal and unavoidable.

Summary

When selecting asphalt roofing materials, all of the factors discussed in the preceding sections (slope, coverage, fire and wind resistance and aesthetics) should be considered. Other inherent characteristics of all asphalt roofing, such as ease of installation and repair, should enter into the analysis when materials other than asphalt roofing are also being considered.

Estimating How Much Roofing is Required

Various types of asphalt roofing materials and accessories are required to complete a typical roofing job, including shingles or roll roofing, underlayment, starter strips, drip edges, valley flashings and hip and ridge shingles. Before the job begins, estimates of the required quantities of each material, based on calculations derived from the dimensions of the roof, must be made.

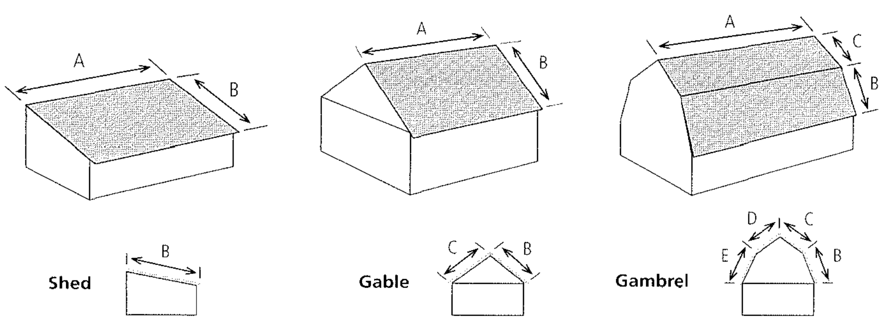
Fairly simple calculations are all that are required. Certain measurement and calculation methods also may be used that simplify the process even further. These are described in the following sections along with suggestions on how to take measurements without getting onto the roof.

Estimating Area (Simple Roofs)

Roofs come in a variety of shapes and styles but virtually every kind of roof is comprised of plane surfaces that can be subdivided into simple geometric shapes — squares, rectangles, trapezoids and triangles. Thus, roofing area calculations simplify to area calculations for these basic shapes.

The simplest type of roof is one without any projecting dormers or intersecting wings. Each of the illustrated roofs is comprised of one or more rectangles. (See Figure 13.) The area of the entire roof in each case is the sum of the areas of each rectangle.

Figure 13
Examples of simple roofs



For the shed roof which has only one rectangle, the area is found by simply multiplying the rake line by the eaves line, or B x A. The gable roof is comprised of two rectangular planes and its area is found by multiplying the sum of the rake lines by the eaves line,

Estimating Area (Simple Roofs)

(continued)

or A(B + C). For the gambrel roof, four rake lines are involved and the total area calculation is found by multiplying the sum of the rake lines by the eaves line, or A(B + C + D + E).

Estimating Area (Complex Roofs)

The more complex roofs include those with intersecting wings or dormer projections through the various roof planes. Area calculations for these roofs use the same basic approach taken for simple roofs but involve a number of subdivisions of the roof surface that are calculated separately, then added together to obtain the total roof area.

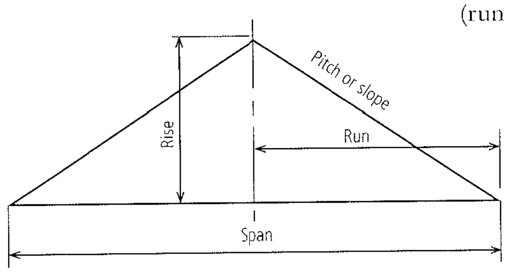
If plans of the building are available, use them to obtain the required roof dimensions from which area calculations can be made. Otherwise, direct measurements may have to be taken on the roof.

However, another alternative exists that enables the estimator to indirectly measure the areas. It involves calculating the projected horizontal areas of the roof, then combining these areas with the roof slope or slopes to obtain the true areas. Both the roof slope and the horizontal projection of the various roof surfaces are determined directly as described in this chapter. Tables are also included in the following sections for converting the indirect measurements and calculations to actual lengths and actual roof areas.

A Roof Pitch and Slope

The degree of incline a roof possesses is usually expressed as its "pitch" or "slope." Pitch is the ratio of the rise of the roof to the span of the roof. (See Figure 14.) Slope is the ratio of rise in inches to horizontal run in feet (run equals half the span). For example, if the span of a roof is 24' and the rise is 8', the pitch is $\frac{8}{24}$ or $\frac{1}{3}$. Expressed as a slope, the same roof is said to rise 8" per foot of horizontal run [Slope (inches per foot) = Rise (in inches) ÷ Run (in feet)]. If the rise of the same roof span were 6', the pitch would be $\frac{1}{4}$ and its slope would be 6" per foot of run. Whether a particular roof incline is expressed in pitch or slope, the results of area calculations will be the same.

Figure 14
Pitch and slope relationships



It is not necessary to go onto a roof to measure pitch or slope. It can be closely approximated from the ground with the aid of a pitch card (available from many manufacturers) or a carpenter's folding rule as follows: Stand away from the building and form the rule into a triangle with the 6" joint at the apex and the 12" joint at one side of the horizontal base line. Holding the rule at arm's length, line up the sides of the

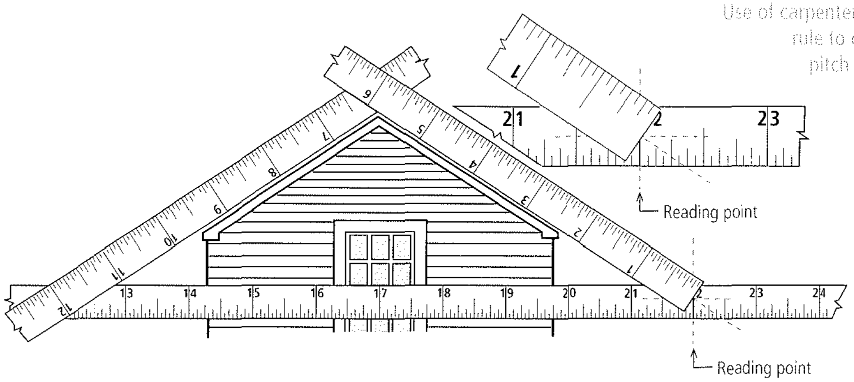
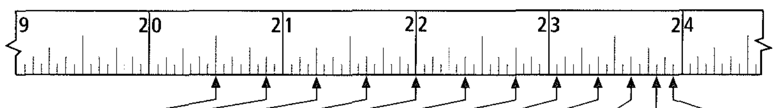


Figure 15
Use of carpenter's folding rule to determine pitch and slope

triangle with the roof as shown in Figure 15, being sure to keep the base of the triangle horizontal. Then, with the zero point of the rule aligned with the center of the base, read the intersection of the zero point with the base. In the example shown in Figure 15, this occurs at the 22" mark. Next, locate the "rule reading" in Figure 16 nearest to the one read in the field and directly under it read the pitch and slope of the roof. For the example, the pitch is read as ⅓, the slope as 8" per foot.

Figure 16
Reading point conversions to pitch and slope



Rule reading	20 1/2	20 7/8	21 1/4	21 5/8	22	22 3/8	22 3/4	23 1/6	23 3/8	23 5/8	23 13/16	23 15/16
Pitch (fraction)	1/2	11/24	5/12	3/8	1/3	7/24	1/4	5/24	1/6	1/8	1/12	1/24
Slope (inches per foot)	12	11	10	9	8	7	6	5	4	3	2	1

(B) Projected Horizontal Area

No matter how complicated a roof may be, its projection onto a horizontal plane will easily define the total horizontal surface the roof covers. Figure 17 illustrates a typical roof complicated by valleys, dormers and ridges at different elevations. The lower half of the figure shows the projection of the roof onto a horizontal plane. In the projection, inclined surfaces appear flat and intersecting surfaces appear as lines.

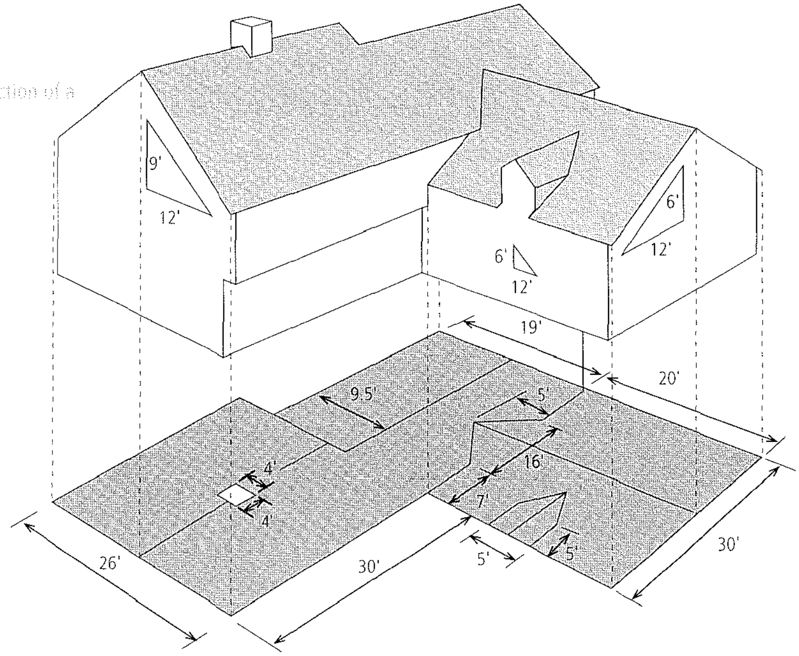
Measurements for the horizontal projection of the roof can be made from the plans, from the ground or from inside the attic. Once the measurements are made, the horizontal area covered by the roof can be drawn to scale and calculated. Sample calculations for the roof in Figure 17, using the dimensions and slopes indicated, appear on the following page.

Because the actual area is a function of the slope, calculations must be grouped in terms of roof slope and those of different slopes are not combined until the true roof areas have been determined.

Estimating Area (Complex Roofs)

(continued)

Figure 17
Horizontal projection of a complex roof



① Calculate the horizontal area under the *9" slope* roof.

② From this gross figure, deductions must be made for the area of the chimney and for the triangular area of the ell roof that overlaps and is sloped differently from the main roof:

③ Calculate the net projected area of the main roof.

④ Calculate the horizontal area under the *6" slope* roof:

① **Calculation for Horizontal Area Under a 9" Slope Roof**

	(26 x 30) = 780
	+ (19 x 30) = 570
Total	= 1350 ft.^{2}

② **Calculation for Deduction of Differently Sloped Areas**

	4 x 4 = 16 Ⓐ
	+ (16 x 5) ÷ 2 = 40 Ⓑ
Total	= 56 ft.^{2}

Ⓐ Chimney Area
Ⓑ Ell roof (triangular area)

③ **Calculation for Net Projected Area of Main Roof**

1,350 ft.^{2} – 56 ft.^{2} = 1,294 ft.^{2}

④ **Calculation for Horizontal Area Under 6" Slope Roof**

	20 x 30 = 600
	+ (16 x 5) ÷ 2 = 40
Total	= 640 ft.^{2}

Ⓒ Duplications

Portions of higher roof surfaces often project over roof surfaces below them but the horizontal projections do not show the overlap. Such duplicated areas should be added to the total horizontal area. Thus, one final correction must be made to account for these overlapped or duplicated areas before the total projected horizontal area is obtained.

In the example, there is an overlap: ① on the 6" slope roof where the dormer eaves overhang the ell roof; ② on the 9" slope roof where the main roof eaves overhang the ell section; and ③ where the main roof eaves overhang the smaller section of the main roof in the rear of the building. In each case, if the eaves extend 4" beyond the structure, the duplication calculations are:

① Two eaves overhangs:
$2(5 \times \frac{4}{12}) = 3\frac{1}{3}$ ft.^{2}

② Two eaves overhangs:
$2(7 \times \frac{4}{12}) = 4\frac{2}{3}$ ft.^{2}

③ Overhang covers only half of the 19' wide section:
$9.5 \times \frac{4}{12} = 3\frac{1}{6}$ ft.^{2}

Item ① should be added to the area of the 6" slope roof and items ② and ③ to the 9" slope roof. Thus, for the 6" slope roof, the adjusted total is 640 + 3 = 643 ft.^{2} and for the 9" slope roof, 1,294 + 8 = 1,302 ft.^{2} (fractions are rounded off to the nearest foot).

Ⓓ Conversion to Actual Area

Now that the total projected horizontal areas for each roof slope have been calculated, the results can be converted to actual areas with the aid of Table 3. (To calculate the Actual Area, multiply the Horizontal Area by the Area/Rake Factor.)

① For the *9" slope* roof:
1,302 ft.^{2} x 1.250 = 1,627.5 ft.^{2}

② For the *6" slope* roof:
643 ft.^{2} x 1.118 = 718.8 ft.^{2}

After the horizontal areas have been converted to actual areas, the results can be added to obtain the total area of roof to be covered:

1,628 ft.^{2} + 719 ft.^{2} = 2,347 ft.^{2}

Table 3: Area/Rake Conversion*

Slope (inches per foot)	Area/Rake Factor
4	1.054
5	1.083
6	1.118
7	1.157
8	1.202
9	1.250
10	1.302
11	1.356
12	1.414

*To use the table, simply multiply the projected horizontal area by the conversion factor for the appropriate roof slope. The result is the actual area of the roof.

Estimating Area (Complex Roofs)

(continued)

[Note]

The same horizontal area projection and roof slope will always result in the same actual area regardless of roof style. In other words, if a shed roof, gable roof or hip roof with or without dormers each covered the same horizontal area and had the same slope, they would each require the same area of roofing to cover them.

For an actual job estimate, an allowance should be made for waste. In this case, assume a 10% waste allowance. Thus, the total area of roofing material required is:

2,347 ft.^{2} + 235 ft.^{2} = 2,582 ft.^{2}

E Additional Material Estimates

To complete the estimate, the required quantity of starter strips, drip edges, hip and ridge shingles and valley strips must be determined. Each of these estimates depends on the length of the eaves, rakes, hips, ridges and valleys at which the material will be applied.

Because eaves and ridges are horizontal, their lengths may be determined directly from the horizontal projection drawing. Rakes, hips and valleys are sloped. Thus, their lengths must be calculated following a procedure similar to that for calculating sloped areas.

To determine the actual length of a rake, measure its projected horizontal distance. Then use Table 3, previously used for *horizontal-to-actual area* conversions, to convert *horizontal-to-actual lengths* by multiplying the rake's projected horizontal distance by the Area/Rake Factor for the appropriate roof slope. The result is the actual length of the rake.

For the house in Figure 17, the rakes at the ends of the main house have horizontal distances of 26' and 19'. There is another rake in the middle of the main house where the higher roof section meets the lower. Its horizontal distance is: 13' + 3.5' = 16.5'. Combine these horizontal distances and multiply by the Area/Rake Factor for the 9" slope roof (from Table 3) to find the Total Actual Length of the rakes.

26' + 19' + 16.5' = 61.5'
61.5' x 1.250 = 76.9'

Following the same procedure for the ell section with its 6" slope roof dormer, the total length of rakes is found to be 39.1'. These rakes can now be added to the total length of eaves (actual horizontal distances, no conversion necessary) to estimate the quantity of drip edge required for the job.

The quantity of ridge shingles required is estimated directly from the drawing since ridge lines are true horizontal distances.

Hips and valleys again involve sloped distances. As a result, their projected horizontal lengths must be converted to actual lengths with the aid of Table 4.

In the following calculations, the total length of valleys for the house in Figure 17 will be determined from which the estimate for valley flashing material can be made.

There is a valley formed on both sides of the ell roof intersection with the main roof. The total measured distance of these valleys on the horizontal projection is 16'.

The fact that two different slopes are involved complicates the procedure somewhat.

If there were only one roof slope, the true length could be calculated directly from Table 4. But in this case, calculations for each slope must be made and then averaged to obtain a close approximation of the true length of the valleys. Using the formula [Horizontal Length x Conversion Factor = Actual Length], the calculation would be:

16' x 1.600 *(9" slope)* = 25.6'
16' x 1.500 *(6" slope)* = 24.0'
Average: (24.0 + 25.6) ÷ 2 = 24.8'

The approximate length of the two valleys is 24.8' or 12.4' each.

Table 4: Hip/Valley Conversion*

Slope (inches per foot)	Hip/Valley Factor
4	1.452
5	1.474
6	1.500
7	1.524
8	1.564
9	1.600
10	1.642
11	1.684
12	1.732

*To use the table, simply multiply the projected horizontal distance of the hip/valley by the conversion factor for the appropriate roof slope. The result is the actual length of the hip/valley.

The total projected horizontal length of the dormer valleys in Figure 17 is 5'. From Table 4, with a 6" slope for both the ell roof and the dormer, the actual length of the valleys is calculated to be 7.5'.

The total length of valleys for the house is: 25' + 7' = 32'. Based on this true length, the amount of valley flashing material can now be estimated.

chapter notes

Preparing for the Job

In addition to roofing materials, a number of accessories will be required for the job along with proper tools and fasteners. Provisions should also be made for storing the materials at the job site. At all times workers should follow safe work practices that help prevent dangerous conditions and possible accidents.

[Note]
All local building codes and city ordinances should be investigated and complied with.

Safety

The best form of accident insurance is accident prevention. Therefore, inspect each job site before the work begins for possible hazards such as overhead electrical lines or unstable ground conditions that might not adequately support ladders or scaffolding. Bring any potentially hazardous conditions to the attention of all workers before the job begins. Adhere to OSHA safety and fall protection standards and observe these general precautions:

- Wear footwear that provides good traction such as rubber-soled shoes with good ankle support.
- Proper eye protection should be worn.
- Do not attempt to work in bad weather or on wet roof decks.
- Do not touch wires crossing over the roof. If cranes are used to raise materials, be sure the operator is aware of overhead power lines or other wires. Keep metal ladders away from power lines.
- Extension ladders should have proper locking devices and be in good condition. Place the ladders at safe angles on stable foundations and properly secure them to prevent movement. Ladders must extend past the edge of the roof by 3' minimum.
- Ropes should be used to secure ladders and scaffolding and used as safety lines for personnel.
- Brace ladders used on the roof deck to the roof structure.
- Avoid leaning away from a ladder to work. Move the ladder as required to follow the work.
- Do not concentrate bundles or rolls of roofing materials on the deck. Distribute them over the entire roof surface to spread the load evenly.
- As the work proceeds, keep the deck clear of unnecessary debris to avoid tripping hazards.
- Always use the proper tools for each segment of the work.
- Remember — Safe roofing is no accident!

Tools

Whether on new construction or a reroofing job, applicators require a number of basic tools to ensure efficient and accurate application of asphalt roofing materials. These include:

Ladders and Scaffolding

Used for access to the roof, for carrying materials up to the roof and for safe footing especially when applying the starter strip and first course.

Tape Measure

Used for making measurements that will be required for an accurate and neat installation.

Chalk

Used for snapping chalk lines that will be used to guide the installation and align the materials over the roof surface.

Roofing Knife

Used for cutting, shaping and fitting the various materials for an accurate, tight-fitting installation.

Hammer, Pneumatic Gun or Roofer's Hatchet

Used for all nailing that will be required. Hatchet may also be used for aligning shingles.

Power Nailers

Pneumatic nailers are designed for a wide variety of applications. Not all are appropriate for the application of roofing shingles. Use only a tool specifically designed by the manufacturer for roofing. It is built to withstand the abrasive nature of roofing material and has features to speed and facilitate the roofing material application.

Pneumatic nailers for roofing are adjustable to achieve proper depth of nail drive.

Correct depth of drive may be achieved by a particular tool through one or more of the following methods as may be recommended by the tool manufacturer:

- Air pressure control
- Selection of proper length driver (driver blade - striker)
- Use of a choke on the tool exhaust system
- Outfitting of a tool with manufacturer approved components such as piston bumper shims, flush drive attachments, and specially-sized variations of standard tool components.

Through repeated contact with the shingles, a buildup of asphalt will occur on the nose of the tool. The installer must periodically clean the tool, or otherwise compensate for this buildup, or fasteners will be underdriven. Cleaning is usually accomplished with environmentally safe solvents applied for immediate removal or overnight soaking of only the nose tool.

Putty Knife, Pointed Trowel or Brush

Used for applying asphalt cements of various viscosities.

Caulking Gun

Used for applying continuous beads of asphalt cement.

Broom

Used for cleaning up after the completed roofing application.

Chisel and Saw

Used for repairing or replacing damaged decking.

Flat Shovel

Used for removing shingles in reroofing applications when existing shingles are in such deteriorated conditions that they must be removed or when shingles must be removed to repair the deck or comply with code requirements.

Primers and Cements

These asphalt based materials are generally used as sealants and adhesives in roofing work. Most of the primers and cements are combustible. They should never be heated over an open fire or placed in direct contact with a hot surface. If they must be softened before application, place the unopened containers in hot water or store them in a warm place until ready for use. Asphalt based sealants and adhesives used in roofing work should comply with all current local, state and federal statutes.

In general, apply asphalt primers and cements to clean, dry surfaces. Trowel or brush them vigorously onto the surface to eliminate air bubbles. The different types of primers and cements include:

Asphalt Plastic Cement (ASTM D 4586)

Also known as flashing cement, this material is generally applied to flashings where the roof meets a wall, chimney, vent pipe or other vertical surface. It is formulated to resist flow at the high surface temperatures normally encountered in summer. The cement remains pliable at low service temperatures.

Lap Cement (ASTM D 3019)

Generally not as viscous as asphalt plastic cement, lap cement is used to provide a watertight bond between lapping plies of roll roofing. Exposed nails used in conjunction with lap cement should pass through the cement so that the shank of the nail is sealed where it penetrates the deck.

Cements and Coatings

(continued)

Asphalt Primer (ASTM D 41)

This is an asphalt based primer used to prepare masonry and metal surfaces for bonding with other asphalt products such as built-up roofing components, asphalt plastic cements or roof coatings. On application, the primer must penetrate the masonry surface pores. Masonry primers have a very fluid consistency and are applied by brushing, rolling or spraying.

Roofing Fabric

Made from asphalt-saturated cotton, glass fiber of other porous fabric, roofing tapes are used in conjunction with asphalt cements and coatings for flashings and for patching seams, breaks and holes in metal and asphalt roofs. The tapes are usually available in rolls up to 50 yards long and 4 to 36" wide.

Application of Strip Shingles On New Construction

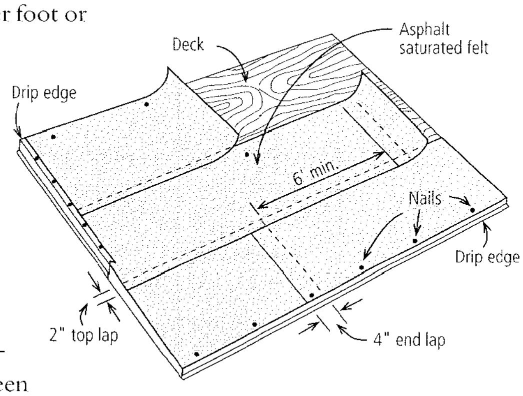
No roof is better than the quality of its installation. Asphalt roofing materials are no exception. They are designed to give years of service when applied carefully and correctly.

Asphalt roofing products are probably the easiest of all roofing materials to install. Even so, there are certain procedures that must be followed to ensure the quality of the installation and of the roof covering itself. These include underlayment installations, alignment techniques and starter strip applications as well as various methods of applying the first and successive courses, fastening the materials to the deck and finishing the hips and ridges. All of these points are discussed below in the order they would be encountered in the field.

Underlayment

After the deck has been properly prepared and is sufficiently dry, cover it with the appropriate underlayment. Typically, asphalt saturated felt products are specified for use as underlayment. However, ambient conditions may warrant the use of a self-adhered eave and flashing membrane (a type of modified bituminous sheet material). Refer to "Eaves Flashing for Ice Dam Protection" on page 43. Underlayment material used beneath roofing shingles is recommended to comply with ASTM D 226, ASTM D 4869, ASTM D 1970 or as recommended by the individual shingle manufacturer.

Figure 18
Application of underlayment



On decks having a slope of 4" per foot or greater, one layer of non-perforated underlayment should be applied. Some local codes may require specific underlayments. The use of asphalt coated base sheets, self-adhered eave and flashing membranes, polyethylene sheets or laminated waterproof papers could result in vapor retardation — trapping moisture or frost between the covering and the roof deck when the deck is not properly ventilated. Consult with the individual manufacturer for specific recommendations when using these types of sheets.

Underlayment
(continued)

Always lay the felt parallel to the eaves, lapping each course at least 2" over the underlying course. Underlayment should not run perpendicular to the eaves. Secure the felt with only enough nails to hold it in place. (See Figure 18 on the previous page.) If two or more pieces are required to continue a course, lap the ends at least 4". End laps in a succeeding course should be located at least 6' from end laps in the preceding course. Lap the felt a minimum of 6" from both sides over all hips, ridges and valleys. Where the roof meets a vertical surface, carry the underlayment at least 4" up the surface.

Underlayment should always be used in new construction as it provides many benefits.

Important reasons for installing underlayment when applying shingles over wood decks include:

- Underlayment is water-resistant and provides secondary protection by helping shield the deck from wind-driven rain and helping prevent water from reaching the deck.
- Underlayment keeps the deck dry until shingles are applied, minimizing problems that may result if shingles are placed on wet decks. Shingles should be applied as soon after the application of the felt as possible.
- Meeting Class A or Class C fire ratings when used with proper decking material and shingles. A shingle by itself is not fire-rated, but is, in fact, a component of a roof assembly. In many municipalities, a Class A or Class C fire rating for roof assemblies is required by code or ordinance.
- Installing underlayment helps reduce "picture framing" (the visible outline of deck panels caused by irregularities in roof decking thicknesses).
- Underlayment offers protection from resins that may come from wood board sheathing.

Proper application techniques should be followed to ensure optimum performance of asphalt saturated felt.

Chalk Line

The dimensional variations of individual strip shingles are seldom significant, but on a large expanse of roof, the accumulated effect of these slight variations could result in divergent butt lines or misaligned cutouts. Whether there is a large expanse of roof or a small one, chalk lines provide visible guides that help ensure the application of the shingles in proper horizontal and vertical alignment with the proper exposure and the intended coverage. Never vary the shingle exposure between courses by more than $\pm \frac{1}{8}$", as this deviation may negatively affect roof performance. Shingle sides should be butted together to maintain adequate shingle coverage.

To place a horizontal chalk line parallel to the eaves, measure the appropriate distance on the roof and mark it at three locations — at each end and in the middle as a check against possible measurement errors. Put a nail on the mark at each end, stretch the chalk line between them and pull it taut. Check the alignment of the middle mark, then snap the line from the center.

Vertical chalk lines are important for aligning cutouts from eaves to ridge. They are also important for aligning shingles on each side of a dormer so that when the application of shingles passes it, the shingles and cutouts meet above the dormer in proper alignment without any gaps or overlaps.

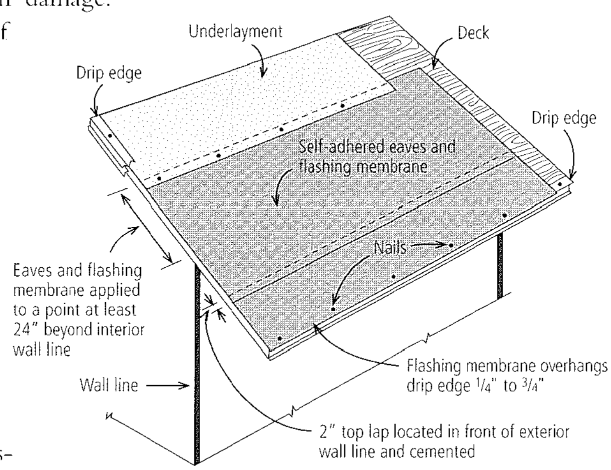
On long runs, snap a vertical chalk line in the center of the run and apply shingles to the left and right of the line. Check horizontal chalk lines as the shingle application approaches the ridge so that the upper courses will be parallel to it.

Eaves Flashing for Ice Dam Protection

Ice dams are formed by the continual thawing of snow over the warmer portions of the roof and refreezing over the cold eave. The ice dams can cause the backing up of water and slush under the exposed roofing material and cause damage to the structure. Eaves flashing is recommended when applying roofing material to this potentially vulnerable area to help prevent such water penetrations. In climates where icing along the eaves is anticipated or where the average January temperature is 25°F or less, eaves flashing must be installed to ensure maximum protection against ice dam damage. The appropriate selection of flashing material and the flashing strip width will depend upon the roof slope and the severity of icing conditions anticipated.

Eaves flashing may be constructed with self-adhered eave and flashing membranes (see Figure 19) or by applying a double underlayment of asphalt saturated felt cemented to each other with plastic cement. Eaves flashing should be installed from the eaves and rakes to a point of at least 24" inside the interior wall line. The eave flashing material should overhang the drip edge by ¼" to ¾". Follow the manufacturers recommendations for installation requirements.

Figure 19
Application of self-adhered eaves and flashing membrane



[Note]

When a self-adhered eave and flashing membrane is used as underlayment, no additional eaves flashing application is required.

Eaves Flashing for Ice Dam Protection

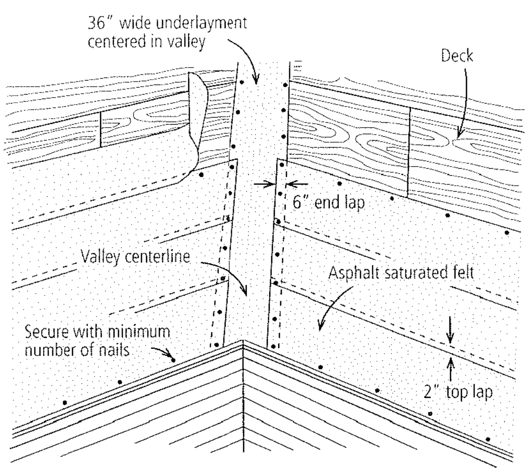
(continued)

Self-adhered eave and flashing membranes are also excellent for use on ridges, hips, flashings and valleys, as well as around dormers, skylights and chimneys. Because most eaves flashing materials are vapor retarders, they should not be used beyond recommended areas without proper ventilation. A lack of proper ventilation in these cases will result in the possibility of water vapor condensation under the roof deck.

Valley Flashing

Valleys are formed where two sloping roof planes meet at an angle. The sloping planes direct water toward the valley, concentrating the drainage along the joint and making it especially vulnerable to leakage. As a result, one of the most important installation details for good roof performance is proper valley flashing. Consult the appropriate roofing manufacturers for recommendations on a particular application.

Figure 20
Application of underlayment in a valley



To install underlayment in a valley, first center a 36" wide strip of the appropriate underlayment in the valley and secure it with only enough nails to hold it in place. Then trim the horizontal courses of felt underlayment applied on the roof to overlap the valley strip at least 6". (See Figure 20.)

Following application of the underlayment, roofs with multiple planes require the construction of one of three types of valleys: open, woven or closed cut. Regardless of the type of valley used, it must be smooth, unobstructed, of sufficient capacity to carry water away rapidly and capable of withstanding occasional backing up of water.

(A) Open Valleys

The recommended flashing material is a 26-gauge galvanized metal or an equivalent corrosion resistant, nonstaining material. (See Figure 21.)

Center the underlayment in the valley. Trim the lower edge flush with the eaves drip edge. Install it up the entire length of the valley. If two or more strips of underlayment are required, lap the upper piece over the lower so that drainage will be carried over the joint, not into it. The overlap should be 12" and fully bonded with asphalt plastic cement. Use only enough nails to hold the strip in place. Nail along a line 1" from each edge. Start at one edge and work all the way up. Then return to nail the other side, pressing the flashing strip firmly into the valley at the same time. In areas of heavy rainfall it may be desirable to use a layer of self-adhered eave and flashing membrane (ice dam membrane) beneath the valley underlayment.

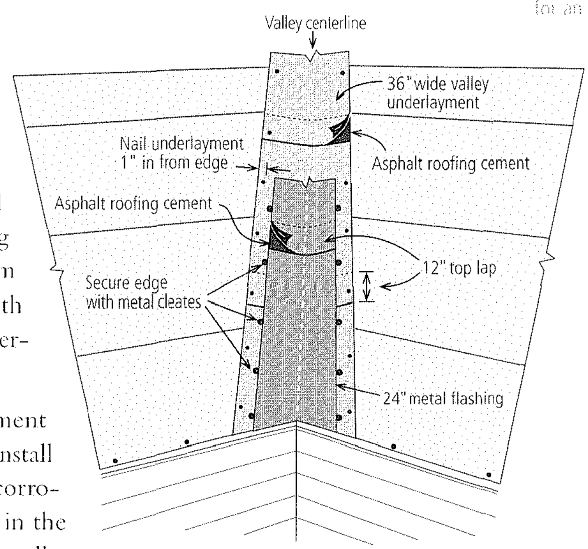


Figure 21
Application of corrosion resistant metal as flashing for an open valley

After the underlayment has been secured, install the recommended corrosion resistant metal in the valley. Secure the valley metal to the roof deck without puncturing, with metal cleats spaced 8"-12" apart. Overlaps should be 12" and cemented. The valley will be completed with shingle application.

Woven and Closed Cut Valleys

Cover both types of valleys with a minimum 36" wide mineral or smooth surfaced roll roofing #50 felt or heavier. Specialty eave flashing may also be used. Center the strip in the valley, securing it with only enough nails to hold it in place. Nail the strip along a line 1" from the edges, first on one edge all the way up, then on the other while pressing the flashing strip firmly and smoothly into the valley. Laps should be 12" and cemented. The valley will be completed as the shingles are installed. When installing a closed-cut valley installation, weave the first course.

Shingle Application

While the general application procedures for all asphalt strip shingles are essentially the same, differences do exist in applying the first shingle in each course and, depending upon the number of cutouts in the strip, in fastening the shingles. Thus, it is necessary to study and follow the shingle manufacturer's application directions as printed on the shingle bundle wrapper.

Before beginning to apply shingles, check that all chimneys are completed and all vent pipes, soil stacks and ventilators are in place. Also make provisions for the additional flashings that will be

Shingle Application
(continued)

required as the shingles are applied such as those around chimneys and stacks and at vertical wall joints.

If a roof surface is broken by a dormer or valley, start applying the shingles from a rake and work toward the break. If the surface is unbroken, start at the rake that is most visible. If both rakes are equally visible, start at the center and work both ways. On hip roofs, start at the center and work both ways.

[Note]
The release tape found on the reverse side of the shingles prevents the shingles from sticking together in the package. It should not be removed during application.

No matter where the application begins, apply the shingles across and diagonally up the roof. This will ensure that each shingle is fastened properly. Straight-up application or "racking" may result in less than the recommended number of nails being used because of the manner in which the shingles have to be applied. "Racking" requires that part of the shingles in some courses be placed under those already applied in the course above. Because part of the shingle is hidden, it may be overlooked when the shingle is fastened. With a diagonal application up the roof, each shingle is completely visible until covered by the course above. "Racking" may accentuate shading tendencies.

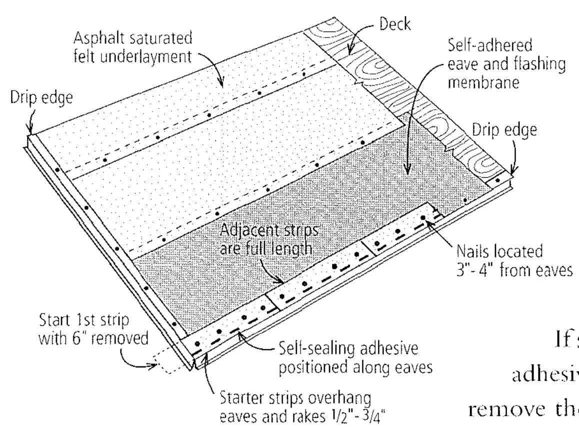
A Starter Strip

The starter strip may be either a row of shingles trimmed to the shingle manufacturer's recommendations or a strip of mineral-surfaced roll roofing at least 7" wide. Pre-cut starter shingles are also available. The starter strip protects the roof by filling in the spaces under the cutouts and joints of the first course of shingles. It should overhang the eaves and rake edges by ½" to ¾".

Where the drip edge extends out from the eaves and rakes, the shingles may be cut flush with the drip edge.

If self-sealing shingles are used for the starter strip, remove the tab portion of each shingle and position the remaining strip with the factory applied adhesive face up along the eaves. Trim at least 4" from the end of the first shingle in the starter strip. Fasten the starter strips parallel to the eaves along a line 3"-4" above the eaves. Position the fasteners so that they will not be exposed under the cutouts in the first course. (See Figure 22.)

Figure 22
Application of starter strip



If shingles without a self-sealing adhesive are used for the starter strip, remove the tab portion of each shingle and position the remaining strip along the eaves. Complete the procedure by following the instructions above.

If roll roofing is used for the starter strip, nail along a line 3"-4" above the eaves. Space the nails 12" apart. This will ensure that the cutouts of the first course of shingles are not placed over the starter strip joints.

(B) First and Succeeding Courses

The first course is the most critical. Be sure it is laid perfectly straight, checking regularly during application against a horizontal chalk line. A few vertical chalk lines aligned with the ends of shingles in the first course will ensure proper alignment of cutouts.

If applying three-tab shingles or if using roll roofing for the starter strip, bond the tabs of each shingle in the first course to the starter strip by placing a spot of asphalt plastic cement (conforming to ASTM D 4586) about the size of a quarter on the starter strip beneath each tab corner. Then press the tabs firmly into the cement.

[Caution]

Excessive use of cement may cause blistering.

The first course starts with a full shingle while succeeding courses start with portions removed according to the style of shingle being applied and the pattern desired. Do not discard the pieces cut from the first shingle in each course. If full tabs, they may be useful for finishing the opposite end of the course or for hip and ridge shingles.

To obtain the correct exposure for square-tab strip shingles, align the butts with the top of the cutouts in the course below. Install no-cutout shingles and those with variable butt lines according to the manufacturer's directions to obtain correct exposure.

There are three different offset methods of applying standard sized three-tab strip shingles: the *6" method*, *5" method* and *4" method*. These methods correspond to the additional amount removed from the first shingle in each successive course to obtain a desired pattern. By removing different amounts from the first shingle, cutouts in one course of shingles do not line up directly with those of the course below.

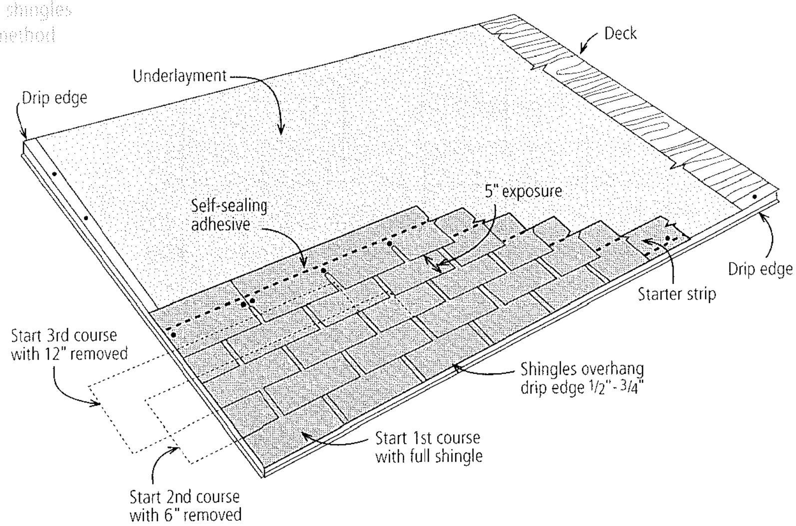
(C) The 6" Method

This method starts each succeeding course after the first and up to the sixth with a shingle from which an additional 6" has been removed. Thus, the first course starts with a full length shingle. The second course then starts with a shingle that has 6" removed and so on through the sixth course which starts with a shingle that has 30" removed. Adjacent shingles in each

Shingle Application
(continued)

course are all full length. The seventh course again starts with a full length shingle and the pattern is repeated every sixth course. (See Figure 23.) When using the 6" method, nominal tolerances in shingle length may affect tab alignment.

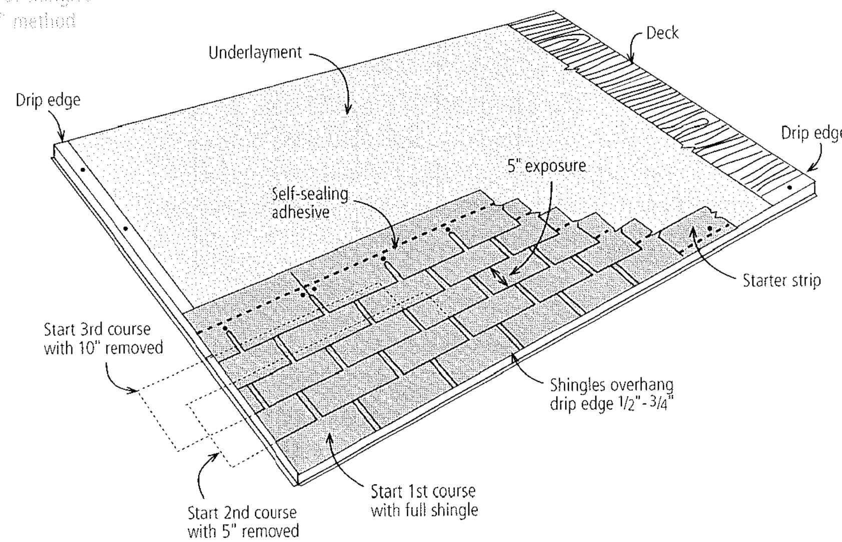
Figure 23
Application of shingles using the 6" method



The 5" Method

With this method of application, the first course begins with a full shingle. The second through seventh courses have an additional 5" removed from the first shingle in each course; i.e. the second course starts with 5" removed from the first shingle, the third course with 10" removed from the first shingle and so on through the seventh course which has 30" removed from the first shingle. Adjacent shingles in each course are full length. Proceed with additional courses to

Figure 24
Application of shingles using the 5" method



continue the 5" offset pattern. One method calls for starting the eighth course with 11" removed from the first shingle. (See Figure 24.)

[Note]

The eighth course does not begin with a shingle that has 35" removed because the remaining 1" width does not lend itself to proper fastening.

B The 4" Method

This method is illustrated in Figure 25. Start the first course with a full shingle. Start the second course with 4" removed from the first shingle, the third course with 8" removed, the fourth with 12" removed and so on through the ninth course which has 32" removed from the first shingle. Adjacent shingles in each course are full length. The tenth course again begins with a full length shingle and the pattern is repeated every ninth course.

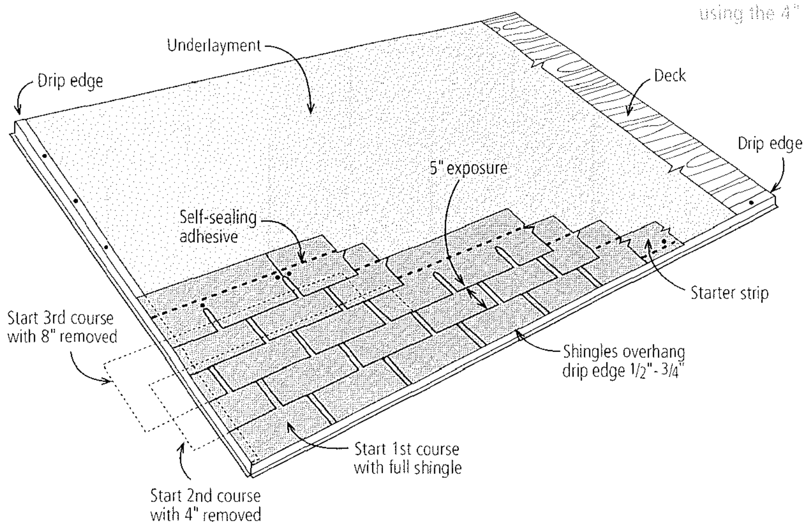


Figure 25
Application of shingles using the 4" method

[Note]

Never use an alignment system where shingle joints are closer than 4" to one another.

Valleys

Several different methods of treating valleys are possible including the open, woven and closed cut methods. Woven or closed cut valleys are the preferred treatment for strip shingles. Open valleys are preferred for individual interlocking type shingles, as the nails required for woven or closed cut construction might be placed at or near the centerline of the valley. For all the methods, valley flashing should be in place before shingle application is begun (See pages 44-45) except for open valleys around dormers where the valley flashing must overlap the top courses of shingles along the dormer sidewalls. Thoroughly working all valley materials well into the break of the valley prior to fastening is recommended.

A Open Valleys

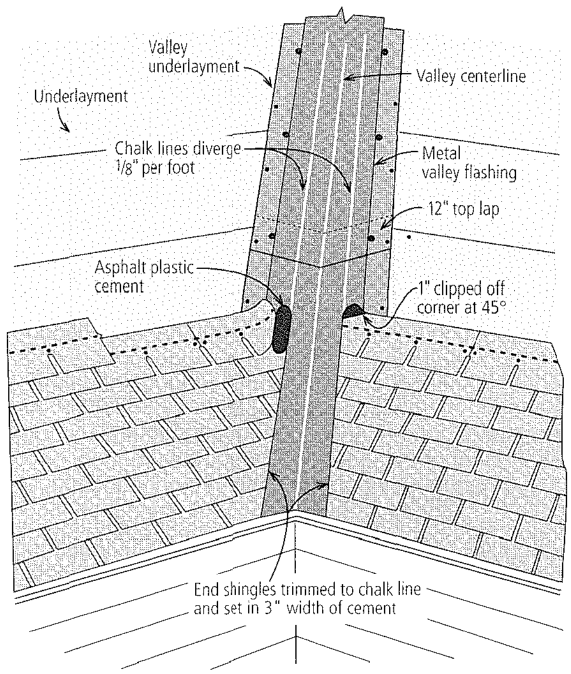
Snap two chalk lines, one on each side of the valley centerline over the full length of the valley flashing. Locate the upper ends of the chalk lines 6" apart at the ridge (i.e., 3" to either

Valleys
(continued)

side of the valley centerline). The lower ends should diverge from each other ⅛" per foot. Thus, for an 8' long valley, the chalk lines should be 7" apart at the eaves; for a 16' valley, they should be 8" apart. (See Figure 26.)

As shingles are applied toward the valley, trim the last shingle in each course to fit on the chalk line. Never use a shingle trimmed to less than 12" in length to finish a course running into a valley. If necessary, trim a tab off the adjacent shingle in the course to allow a longer portion to be used. Clip 1" from the upper corner of the shingle on a 45° angle to direct water into the valley and prevent if from penetrating between the courses. Finally, to form a tight seal, cement the shingle to the valley lining with a 3" width of asphalt plastic cement (conforming to ASTM D 4586). There should be no exposed nails along the valley flashing.

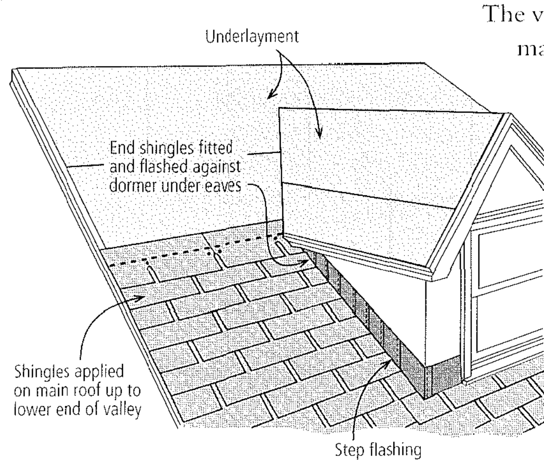
Figure 26
Application of shingles in an open valley



Open Valleys for Dormer Roofs

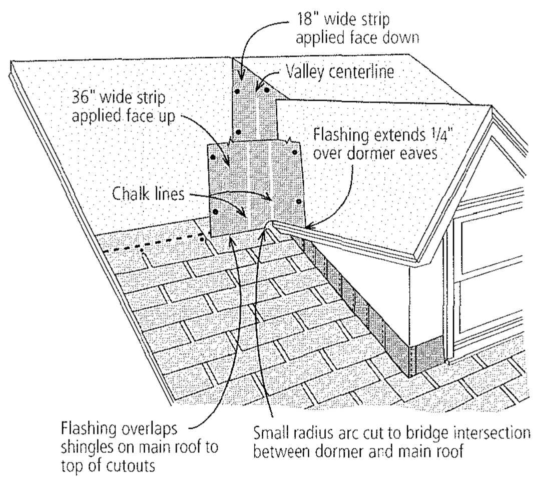
The valley between a dormer and main roof requires special treatment. Do not install valley flashing until the shingle application reaches a point just above the lower end of the valley. (See Figure 27.)

Figure 27
Point at which installation of open valley at dormer roof begins



Apply the first or bottom layer of valley flashing (18" wide, mineral-surfaced roll roofing) in the same manner as any open valley flashing. Trim the lower section of the flashing so that it extends ¼" below the edge of the dormer deck. The lower section in contact with the main roof deck should project at least 2" below the point where the two roofs meet. Extend the upper section so that the portion on the main roof extends 18" above the point where the dormer intersects the roof. Trim the portion on the dormer at the ridge. (See Figure 28.)

Figure 28
Application of mineral-surfaced roll roofing as flashing for an open valley at a dormer roof

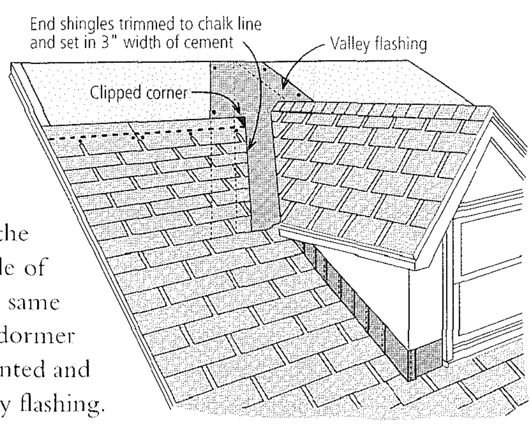


Apply valley flashing on the other side of the dormer in the same manner, extending the portion on the main roof up and over the portion from the first valley. Cement and nail the overlap. Lap the flashing on the dormer side over the ridge, then cement and nail it.

Trim the second or top layer of flashing (36" wide, mineral-surfaced roll roofing) on the dormer side to match the lower end of the underlying 18" strip. Trim the side that will lie on the main deck to overlap the nearest course of shingles. This overlap is the same as the normal lap of one shingle over another for the shingles being applied. For example, for three-tab strip shingles, it extends to the top of the cutouts.

Nail the top flashing strip over the bottom as in standard open valley construction. Work the flashing into the valley joint so that it lies flat and smooth in both planes up to the edge of the dormer eaves. Trim the top layer horizontally on a line with the top of the dormer ridge where it intersects the main roof.

Figure 29
Shingle application in an open valley at dormer roof



Apply the top layer in the valley on the other side of the dormer in the same manner except at the dormer ridge where it is cemented and nailed to the first valley flashing.

Valleys
(continued)

Trim the lower end of the flashing on a small radius arc that bridges slightly over the point of intersection between the dormer and main roof. This shape forms a small canopy over the joint between the two decks.

Snap chalk lines on the valley flashing 3" on each side of the centerline at the top and diverging ⅛" per foot to the bottom of the valley. Resume the shingle application, trimming the end shingle in each course to the chalk lines. Clip the upper corner and embed the end shingle in a 3" wide strip of asphalt roofing cement (conforming to ASTM D 4586) to seal it to the flashing. Complete the valley construction in the usual manner. (See Figure 29.)

After shingles have been applied to both sides of the dormer roof, apply the dormer ridge shingles. Start at the front of the dormer and work toward the main roof. Apply the shingles as described later in this chapter in the section on "Hips and Ridges." Apply the last ridge shingle so that it extends at least 4" onto the main roof. Slit the center of the portion attached to the main roof and nail it into place. Then apply the main roof courses to cover the portion of the last ridge shingle on the main roof. Snap chalk lines so that the shingles on the main roof will continue the same alignment pattern on both sides of the dormer as shown in Figure 30.

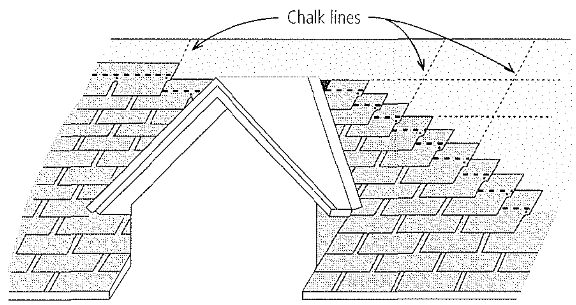


Figure 30
Proper alignment of shingles and cutouts above dormer using chalk lines

Closed Cut Valleys

With valley flashing already in place, apply the first course of shingles along the eaves of one of the intersecting roof planes and across the valley. The first course and only the first course of shingles from the intersecting roof surface should be woven with the first course of shingles on the starting roof. For proper flow of water over the trimmed shingle, always start applying the shingles on the roof plane that has the lower slope or lesser height. Extend the end shingle at least 12" onto the adjoining roof. Do not make a joint in the valley. If a shingle falls short, add in a one or two tab section so that the joint occurs outside the line of the valley. Apply succeeding courses in the same manner, extending them across the valley and onto the adjoining roof. Press the shingles tightly into

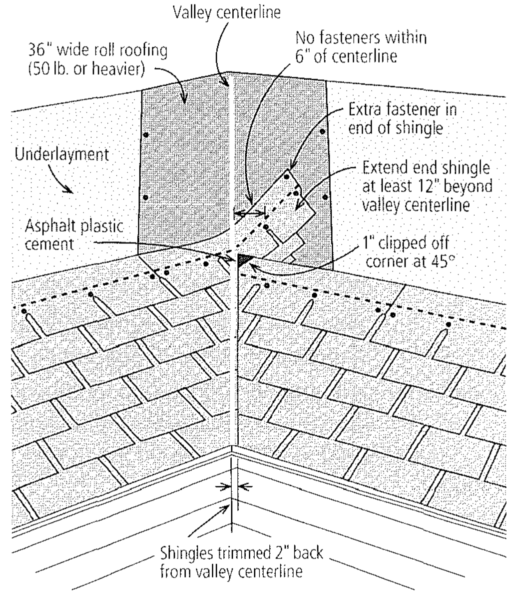
[Note]

The first course and only the first course of shingles from the intersecting roof surface should be woven with the first course of shingles on the starting roof.

the valley. Use normal shingle fastening methods except that no fastener should be within 6" of the valley centerline and two fasteners should be placed at the end of each shingle crossing the valley.

Snap a chalk line 2" from the centerline of the valley on the unshingled side. Then apply shingles on the unshingled side. Trim the shingles as they are being installed to the chalk lines and to ensure a neat installation. Trim 1" on a 45° angle from the upper corner of each end shingle upon installation. This will direct water into the valley. Finally, embed the end of each shingle in a 3" wide strip of asphalt plastic cement. (See Figure 31.)

Figure 31
Shingle application in a closed cut valley

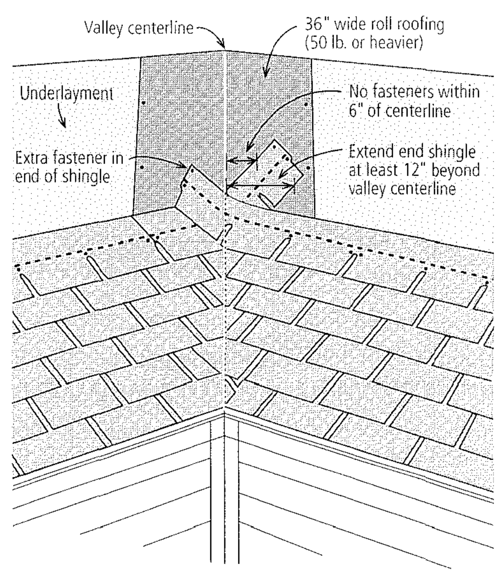


Ⓓ Woven Valleys

The valley flashing should already be in place as described earlier. Shingles on the intersecting roof surfaces may be applied toward the valley from both roof areas simultaneously or each roof area may be worked separately up to a point about 3' from the center of the valley and the gap closed later.

Regardless of which procedure is followed, apply the first course along the eaves of one roof area up to and over the valley with the last shingle extending at least 12"

Figure 32
Shingle application in a woven valley



Valleys
(continued)

onto the intersecting roof. Then apply the first course onto the intersecting roof along the eaves and extend it across the valley over the top of the shingles already crossing the valley and at least 12" onto the other roof surface. Apply successive courses alternately from the adjoining roof areas, weaving the valley shingles over each other as shown in Figure 32. Press each shingle tightly into the valley and follow the same nailing procedures as the closed cut valley.

Flashing

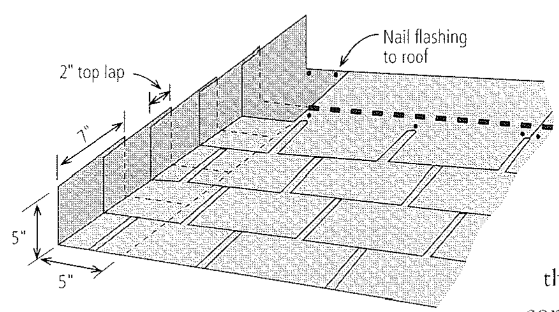
All areas on the roof surface where there is an intersection of roof planes or a projection through the roof surface (i.e., chimneys, vent stacks, dormer walls, etc.) require "flashing." Flashing is the construction procedure necessary to make these areas watertight. Careful attention to flashing details is essential to proper leak-free roof performance.

Ⓐ Flashing Against Vertical Sidewalls

Roof planes that butt against vertical walls at the end of shingle courses are best protected by metal "flashing shingles" placed over the end of each course. The method is called "step flashing."

The metal flashing shingles are rectangular, 10" long and 2" wider than the expected face of the roofing shingles. For example, when used with strip shingles with a 5" exposure, they are 10" x 7". The 10" length is bent to extend 5" over the roof deck and 5" up the wall surface. Each flashing unit is placed just up roof from the exposed edge of the shingle that will overlap it so that it is not visible when the overlapping shingle is in place. (See Figure 33.)

Figure 33
Application of step flashing



To install step flashing, place the first flashing unit over the end of the starter strip and position it so that the tab of the end shingle in the first course covers it completely. Secure the horizontal flange to the roof with two nails. Do not nail flashing to the wall as settling of the roof could damage the seal. Then apply the first course of shingles up to the wall. Position the second step flashing strip over the end shingle in the first course 5" up from the butt so that the tab of the end shingle in the second course covers it completely. Fasten the horizontal flange to the roof. The second course of shingles follows, the end is flashed as in preceding courses and so on to the top of the intersection. Because the metal strip is 7" wide and roof shingles are laid with a 5" exposure, each flashing unit will overlap the one on the course below by 2".

Bring siding down over the vertical sections of the step flashing to serve as counter flashing. Keep wood siding far enough away from the roof shingles so that it may be painted. (See Figure 34.)

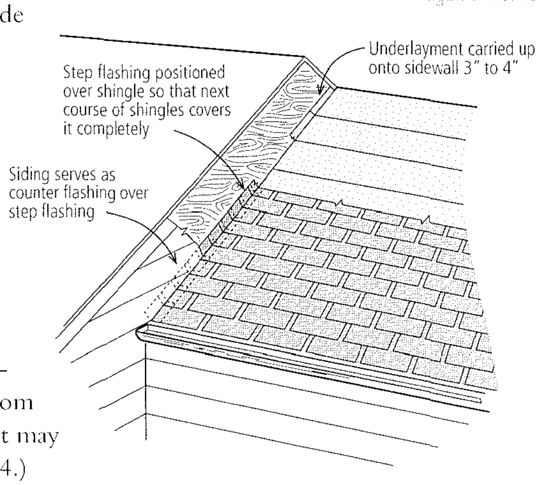


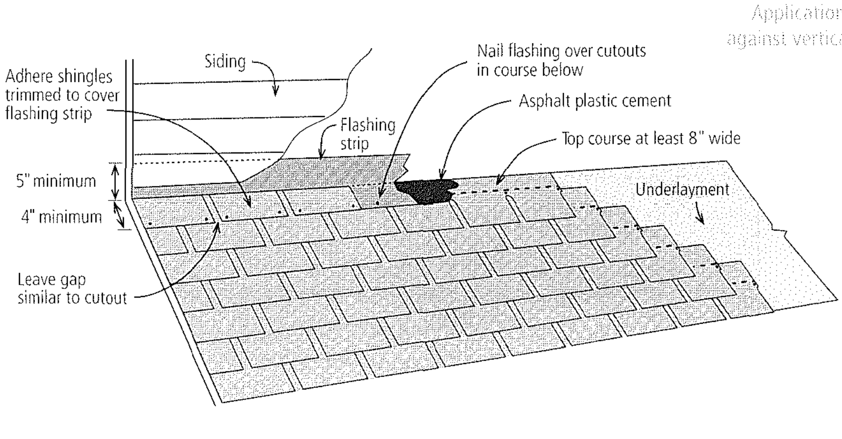
Figure 34
Application of step flashing against vertical sidewall

B Flashing Against Vertical Front Walls

Apply shingles up the roof until a course must be trimmed to fit at the base of the vertical wall. Plan ahead and adjust the exposure slightly in the previous two courses so that the last course is at least 8" wide. Apply a continuous piece of metal flashing over the last course of shingles by embedding it in asphalt plastic cement and nailing it to the roof. The metal flashing strip should be bent to extend at least 5" up the vertical wall and at least 4" onto the last shingle course. Do not nail the strip to the wall. Apply an additional row of shingles in asphalt roofing cement (conforming to ASTM D 4586) over the metal flashing strip, trimmed to the width of the strip. (See Figure 35.)

Bring siding down over the vertical flashing to serve as cap flashing. Keep wood siding far enough away from the roof shingles so that it may be painted. Do not nail siding into the vertical flashing.

Figure 35
Application of flashing against vertical front wall



Flashing

(continued)

If the vertical front wall meets a sidewall, as in dormer construction, cut flashing so that it extends at least 7" around the corner. Then continue up the sidewall with step flashing as described earlier.

Soil Stacks and Vent Pipes

Practically all dwellings have vent pipes or ventilators projecting through the roof that are circular in section and require special flashing methods.

Figure 36
Application of shingle over vent pipe

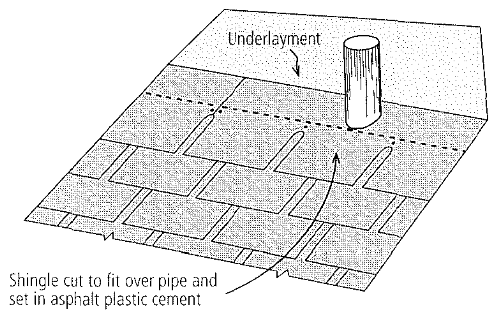


Figure 37
Application of flashing over vent pipe

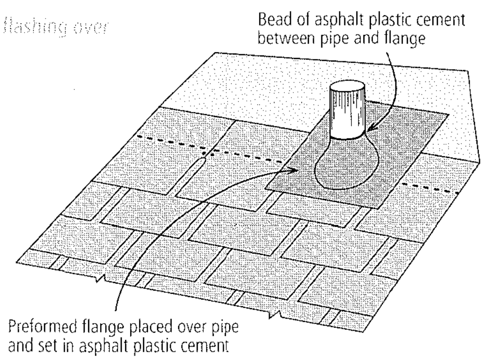
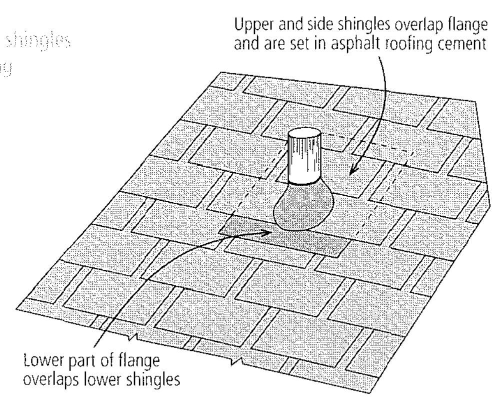


Figure 38
Application of shingles around flashing



Apply shingles up to the vent pipe. Then cut a hole in a shingle to go over the pipe and set the shingle in asphalt roofing cement conforming to ASTM D 4586. (See Figure 36.) A preformed flashing flange that fits snugly over the pipe is then placed over the shingle and vent pipe and set in asphalt plastic cement. Place the flange over the pipe to lay flat on the roof. (See Figure 37.)

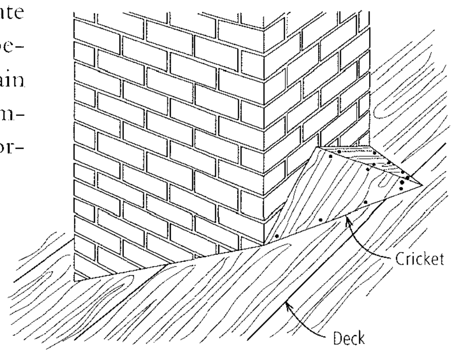
After the flashing is in place, resume shingle application. Cut shingles in successive courses to fit around the pipe and embed them in asphalt plastic roofing cement where they overlay the flange. Avoid excessive use of cement as it may cause blistering. Do not drive fasteners close to the pipe. The completed installation should appear as shown in Figure 38 with the lower part of the flange overlapping the lower shingles and the side and upper shingles overlapping the flange.

Follow the same procedure where a ventilator or exhaust stack is located at the ridge, but bring the shingles up to the pipe from both sides and bend the flange over the ridge to lie in both roof planes, overlapping the roof shingles at all points. Ridge shingles are then positioned to cover the flange. Embed the ridge shingles in asphalt plastic cement where they overlap the flange.

D Flashing Around Chimneys

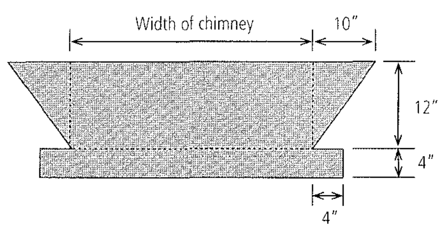
To prevent problems that uneven settling could cause, chimneys on older homes were usually built on a separate foundation from that of the main structure. This does not eliminate possible differential settling between the chimney and the main structure. It only frees the chimney from the stresses and distortions that would be imposed on it if both were on the same foundation.

Figure 39
Location and configuration of chimney cricket



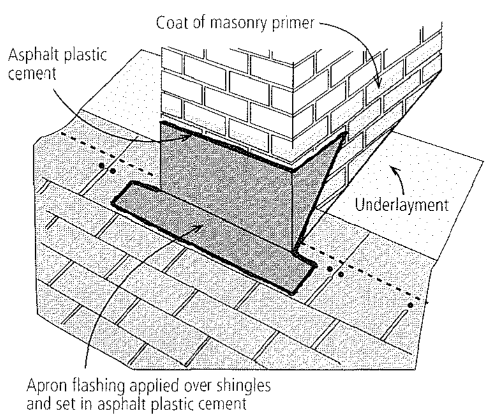
Because of these differential movements, flashings at the point where the chimney projects through the roof calls for a construction that will allow movement without damage to the water seal. To accomplish this, it is necessary to apply apron flashings that are secured to the roof deck and counter flashings that are secured to the masonry. If movement occurs, the counter flashing slides over the apron flashing without affecting water runoff.

Figure 40
Pattern for cutting front apron flashing



Chimneys which project through the roof surface should have a cricket installed at the intersection of the back face of the chimney and the roof deck. The cricket (or wood saddle) is an important element in preserving the integrity of the flashing that will be installed because it prevents

Figure 41
Application of apron flashing at front of chimney

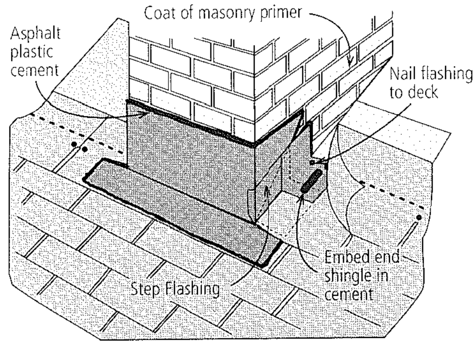


Flashing
(continued)

the buildup of ice and snow at the rear of the chimney and diverts water runoff around the chimney. (See Figure 39.)

The cricket should be in place from the start because all roofing materials from the felt underlayment to the roofing shingles are carried over it. If it is not in place, build one as part of the deck preparation prior to applying underlayment and shingles.

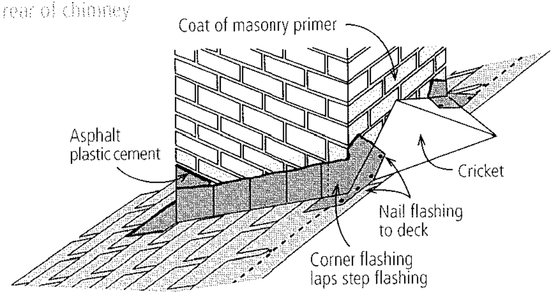
Figure 42
Application of step flashing at side of chimney



Commonly, a cricket consists of two triangular sections of sheathing supported by appropriate framing members, joined to form a level ridge that extends from the centerline of the chimney back to the roof deck. Nail the sections to the deck and to each other along their meeting edge.

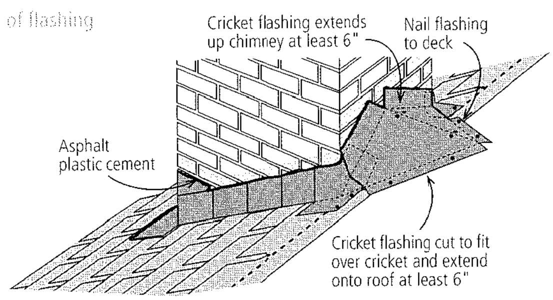
Apply shingles up to the front edge of the chimney before any flashings are installed. In addition, apply a coat of asphaltic masonry primer (conforming to ASTM D 41) to the chimney's brickwork to seal the surface and to provide good adhesion at all points where asphalt plastic cement will later be applied.

Figure 43
Application of corner flashing at rear of chimney



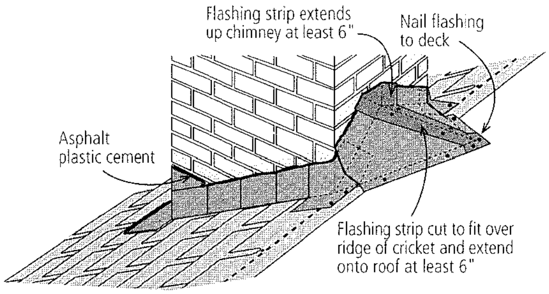
Begin the flashing construction with the installation of 26-gauge corrosion-resistant metal apron flashing between the chimney and the roof deck on all sides.

Figure 44
Application of flashing over cricket



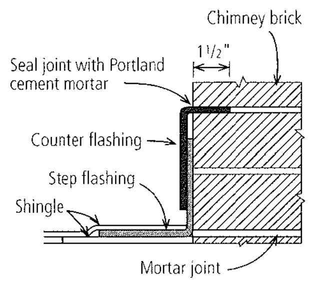
Apply the apron flashing to the front first as shown in Figures 40 and 41 on the previous page. Bend the apron flashing so that the lower section extends at least 4" over the shingles and the upper section extends at least 12" up the vertical face of the chimney. Work the flashing firmly and smoothly into the joint between the shingles and chimney. Set both the roof and chimney overlaps in asphalt plastic cement placed over the shingles and on the chimney face. The flashing may be secured against the chimney with one or two nails driven into the mortar joints to hold it in place until the cement sets.

Figure 45
Application of flashing over ridge of cricket



Use metal step flashing for the sides of the chimney, positioning the units in the same manner as flashing a vertical sidewall. Cut, bend and apply the step flashing as shown in Figure 42. Secure each flashing unit to the masonry with asphalt plastic cement and to the deck with nails. Embed the end shingles in each course that overlaps the flashing in asphalt plastic cement.

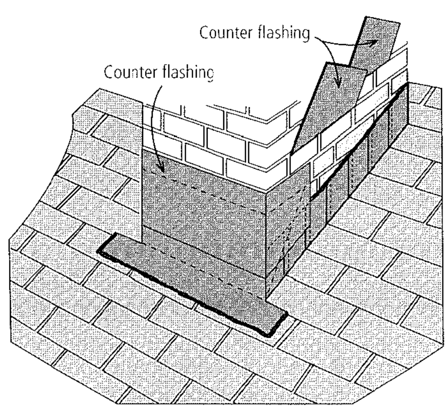
Figure 46
Application of counter flashing



Place the rear cricket flashing over the base and the back of the chimney as shown in Figures 43 through 45. Cut and bend the metal cricket flashing to cover the cricket and extend onto the roof surface at least 6". It should also extend at least 6" up the brickwork and far enough laterally to lap the step flashing on the sides.

If large enough, the base may be covered with shingles. Otherwise, apply the rear apron flashing, bring the end shingles in each course up to the cricket and cement them in place.

Figure 47
Application of counter flashing at front and side of chimney



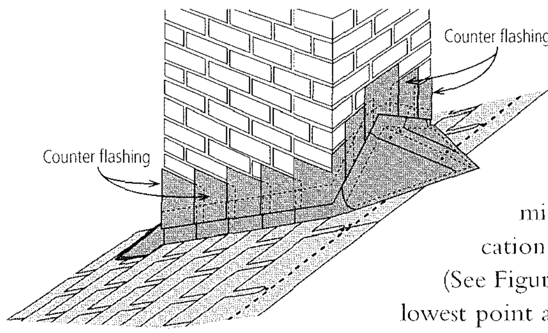
Counter flashings must now be placed over all apron, cricket and step flashings for positive exclusion of water from the joint. Begin by setting the metal counter flashing into the brickwork as shown in Figure 46. This is done by raking out a mortar joint to a depth of 1½" and inserting the bent edge

Flashing

(continued)

of the flashing into the cleared joint. Once in place and being under a slight amount of spring tension, the flashing cannot be dislodged easily. Refill the joint with Portland cement mortar. Finally, bend the flashing down to cover the flashing and to lie snugly against the masonry.

Figure 48
Application of counter flashing at side and rear of chimney



Use one continuous piece of counter flashing on the front of the chimney as shown in Figure 47. On the sides and back of the chimney, use several pieces of similar-sized flashing, trimming each to fit the particular location of brick joint and roof pitch. (See Figure 48.) Start the side units at the lowest point and overlap each at least 3". As this is a metal cricket, it should be left unshingled in case a leak occurs (a leak would not be readily detectable if the cricket were shingled).

Hips and Ridges

Apply shingles up to a hip or ridge from both sides of the roof before finishing the intersection. To facilitate finishing, adjust the last few courses so that the ridge capping will adequately cover the top courses of shingles equally on both sides of the ridge.

Some manufacturers supply special hip and ridge shingles and specify how they should be applied. Hip and ridge shingles also may be made from the 12" x 36" strip shingles used to cover the roof. Cut the strip shingles down to 12" x 12" on three-tab shingles or to a minimum of 9" x 12" on two-tab or no-cutout shingles. Taper the lap portion of each cap

Figure 49
Fabrication of hip and ridge shingles from three-tab strip shingles

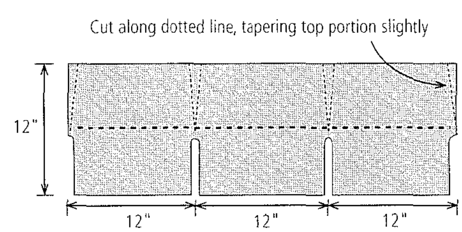
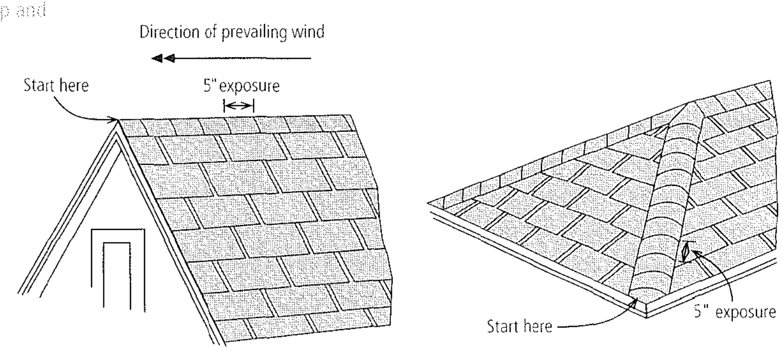


Figure 50
Application of hip and ridge shingles



shingle slightly so that it is narrower than the exposed portion. This produces a neater job. (See Figure 49.)

To apply the ridge shingles, bend each shingle along the centerline so that it will extend an equal distance on each side of the hip or ridge. Chalk lines may assist in proper alignment. In cold weather, warm the shingle until it is pliable before bending. Apply the shingles with a 5" exposure, beginning at the bottom of the hip or from the end of the ridge opposite the direction of the prevailing winds. See Figure 51. Secure each shingle as illustrated in Figure 52 with one fastener on each side, 5½" back from the exposed end and 1" up from the edge. Length of fastener for hip and ridge shingles should be ¼" longer than recommended for shingles.

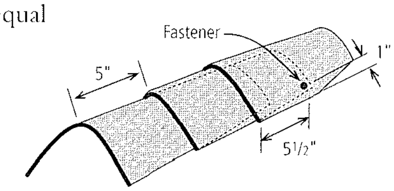


Figure 51
Fastener location of hip and ridge shingles

chapter notes

Application of Strip Shingles on Low and Steep Slopes

Low Slope Applications

Asphalt strip shingles may be used on slopes ranging from 2"-4" per foot if special procedures are followed. Never use shingles on slopes lower than 2" per foot.

Low slopes can lead to problems because water drains slowly from these slopes, creating the greater possibility of water backup and damage from ice dams. The special application method described below for applying shingles on low slopes ensures that the roof remains weather-tight.

Ⓐ Underlayment

On low slope applications, cover the deck with two layers of non-perforated asphalt saturated felt or one layer of an appropriate self-adhered eave and flashing membrane. Begin by fastening a 19" wide strip of underlayment placed along the eaves and overhanging the drip edge by ¼" to ¾". Place a full width sheet over the starter with the long edge placed along the eaves and completely overlapping the starter strip.

All succeeding courses will be a minimum of 36" wide and should be positioned to overlap the preceding course by 19". Secure each course by using only enough fasteners to hold it in place until the shingles are applied. End laps should be 12" wide and located at least 6' from end laps in the preceding course.

Ⓑ Eaves Flashing for Ice Dam Protection

Wherever there is a possibility of ice buildup along the eaves or a backup of water from pine needles or leaves, cement all laps in the underlayment courses from the eaves to a point at least 24" beyond the interior wall line of the building using asphalt plastic roofing cement (conforming to ASTM D 4586) or asphalt lap cement (conforming to ASTM D 3019). The cemented double ply underlayment serves as the eaves flashing. (See Figure 52.)

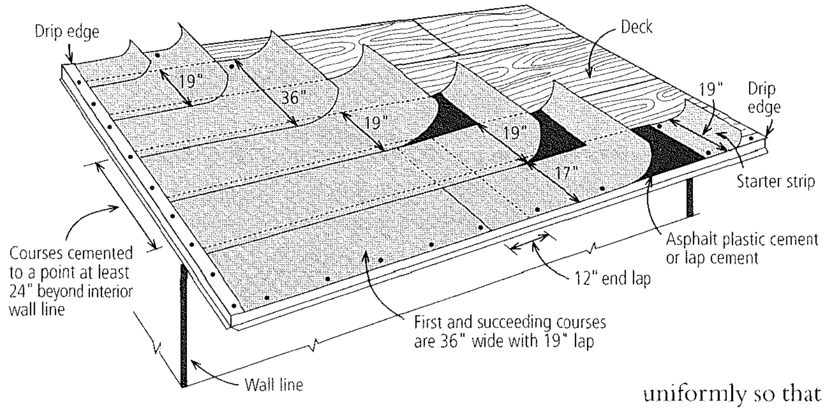
To construct the eaves flashing, cover the entire surface of the starter strip with a continuous layer of asphalt plastic cement applied at the rate of 2 gallons per 100 ft.^{2}; alternatively lap cement may be used at a rate of 1 gallon per 100 ft.^{2}.

Low Slope Applications
(continued)

Consult with the individual manufacturer, as specifications may vary. Place the first course over the starter, pressing it firmly into the cement.

After the first course is in place, coat the upper 19" with cement. Position the second course and press it into the cement. Repeat the procedure for each course that lies within the eaves flashing distance. It is important to apply the cement uniformly so that the overlapping felt will float completely on the cement without touching the felt in the underlying course. Avoid excessive use of cement as it may cause blistering. It is recommended that asphalt plastic cement conforming to ASTM D 4586 be used.

Figure 52
Application of underlayment on low slopes where icing along the eaves is anticipated

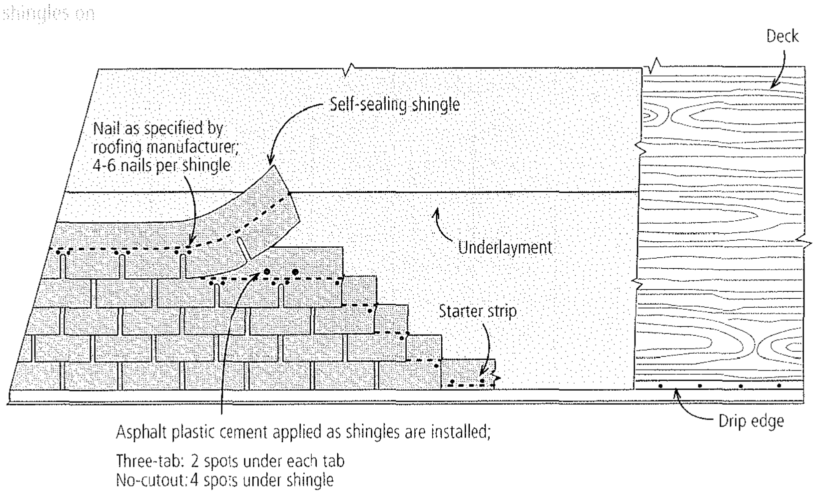


[Note]

Self-adhered eave and flashing membranes are commonly used for ice dam protection. If one of these products is used, follow the manufacturer's application instructions.

After completing the eaves flashing, secure each successive course by using only enough fasteners to hold it in place until the shingles are applied. Use care when walking on the eaves flashing prior to application of shingles.

Figure 53
Application of shingles on steep slopes



(B) Shingle Application

For increased wind resistance on low slope applications, either use self-sealing shingles that incorporate a factory applied adhesive or cement the tabs of free tab shingles to the underlying course. To cement a free tab shingle to the underlying course, place a spot of asphalt plastic cement about the size of a quarter under the corner of each tab (2 per tab). Then press the tab into the adhesive. Be sure to cement all tabs throughout the roof. Any of the shingle application methods discussed in Chapter 7 may be used on low slopes.

Steep Slope Applications

Recent architectural trends that make much greater use of steep slopes have created radical departures from traditional roof concepts. Mansard roofs are perhaps the best examples of these trends.

Steep slopes tend to reduce the effectiveness of factory-applied self-sealing adhesives especially on colder or shaded areas of the roof. Thus, special application methods may be necessary.

The maximum slope on which shingles may be applied using normal methods is 21" per foot. Application of shingles on roof slopes exceeding this limit should follow the special method described below for strip shingles with a nominal 5" exposure. (See Figure 53).

Application procedures for underlayments, drip edges, eaves flashing (if required) and other flashings are the same as those for normal slopes.

(A) Shingle Application

Apply the shingles with fasteners recommended by the roofing manufacturer. Also follow the roofing manufacturer's recommendations as to the number of fasteners required per shingle and their position. Do not drive fasteners into or above the factory applied adhesive when self-sealing shingles are used.

Immediately upon installation, cement each tab in place with an asphalt plastic roofing cement recommended by the shingle manufacturer. Apply the adhesive in spots equivalent to the size of a quarter. For shingles with two or more tabs, place a spot of cement under the corner of each tab (2 per tab). Then press the tab into the adhesive. Be sure to cement all tabs throughout the roof. For no-cutout shingles, place four (4) evenly spaced spots of cement under the exposed portion of the shingle.

Steep Slope Applications
(continued)

It is also important that thorough ventilation be provided in the space behind the roof deck to prevent moisture laden air from being trapped behind the sheathing. If no ventilation is provided, the sheathing may buckle and the shingles may buckle and/or blister.

For strip shingles with more than a nominal 5" exposure, refer to the roofing manufacturer's application instructions.

Application of Strip Shingles for Reroofing

Many of the procedures used for applying shingles on new roofs are also followed in reroofing. However, other procedures specifically designed for reroofing applications have been developed to meet the particular requirements of this type of work. The differences depend primarily on the type of material that is on the existing roof, its condition and whether the new roofing can be placed over it.

Deck Preparation

When starting a reroofing job, the first step is to decide whether the existing roofing should remain in place or be removed. Complete removal may be desirable in some cases and necessary in others. In general, roofs covered with wood shingles, asphalt shingles, asphalt roll roofing, slate or built-up asphalt roofing may be left in place. Depending on local building codes, a maximum of three roofs (original and two reroofs) may be installed before a tearoff becomes mandatory. Tile or cedar shake roofs must be removed because of their irregular surface and the difficulty in fastening through them.

The main consideration, however, is the condition of the framing beneath the existing roof because new material installed on top of the old will add weight to the structure. The roof framing must be strong enough to support these additional loads plus the weight of the roofers and their equipment.

Another important consideration is the fastening anchorage that the existing deck will provide. If the deck has deteriorated to the point where it will not provide adequate anchorage for new roofing fasteners, it should be replaced.

Another factor is the condition of the surface on which the new roofing will be applied. If the surface of old asphalt roofing or wood shingles is warped, curled or badly weathered to the point where providing a level surface for the new material will be difficult, it should be removed. If the surface is defective to the point where it probably will not provide adequate protection as an underlayment, if there are holes in the existing materials or if there are depressions or sagging that indicate possible structural problems, the surface should be removed and remedial work performed on the underlying deck and roof structure, as necessary.

Deck Preparation
(continued)

Asphalt shingle roofs that have lost most or all of their protective mineral granules may still be a satisfactory base for new asphalt shingles provided the remainder of the roof structure is adequate. Wood shingles also may be left in place and the surface modified where necessary to provide a relatively smooth base on which new asphalt shingles may be placed.

Regardless of whether the existing material remains or not, inspect adjacent parts of the building for defects before starting to reroof. Repair or replace rotting or deteriorated wood trim. If necessary, refill chimney mortar joints and replace all worn flashings. Clean, rebuild, replace or reline gutters. Make sure there is adequate under-roof ventilation. (To avoid condensation problems, a structure's ventilation should be carefully reexamined when performing any type of remodeling, not only reroofing.) After correcting or repairing problem areas, clean all debris from the roof surface.

After all repairs are made and the deck is properly prepared, application of the shingles follows the same procedures as new construction with underlayments, drip edges, eaves flashing, valley flashings and other flashings placed where necessary.

A Old Roofing Removed

If existing roofing must be removed, completely strip the materials down to the roof deck. If the deck under wood shingles or shakes consists of spaced sheathing, start removing old shingles at the ridge so that broken material will not fall through the open sheathing into the attic where it will create a fire hazard and cleanup problem. Do not install plywood over spaced sheathing without providing adequate ventilation.

Flat-surfaced shovels are convenient for removing old asphalt shingles, wood shingles, built-up roofing and felt underlayments. Be sure that all old fasteners are removed from the surface. Use a pry bar to remove soil stack and vent flashings if they are not serviceable. Be careful not to damage old metal flashings that may be used as a pattern for cutting new ones. If metal cap flashings at the chimney and other vertical masonry wall intersections have not deteriorated, bend them up out of the way so that they may be used again. Carefully remove shingles in these areas to avoid damaging reusable base flashing. For safety, keep the deck clear of waste material as the work proceeds. Sweep the deck clean after all old roofing has been removed.

Inspect the deck to determine whether it is sound. Make whatever repairs are necessary to the existing roof framing to strengthen it and to level and true the deck. Replace rotted, damaged, warped or delaminated plywood or sheathing with approved material. Cover all large cracks, knot holes, loose knots and resinous areas in the deck with sheet metal patches nailed to the sheathing. Remove loose or protruding nails or hammer them down. If the deck consists of spaced sheathing, fill in all spaces with new boards of the same thickness as the old deck or cover the entire area with decking of the type and thickness required by local codes or the shingle manufacturer.

Sweep the deck clean again, then follow the application directions described in Chapter 7 for new construction. Flashing details generally follow those for new construction but may differ in some respects. The last section of this chapter discusses reroofing flashing procedures.

(B) Old Roofing Remains in Place

Preparatory procedures depend on the type of existing roofing. Five situations are generally encountered: asphalt shingles over old asphalt shingles, over wood shingles, over roll roofing, over slate and over built-up roofing. Some shingles have a greater tendency to reveal the unevenness of the surface over which they are applied. This phenomenon is known as telegraphing, and may influence the choice of roofing material. If you believe telegraphing may be a problem, consult individual manufacturers for advice before proceeding with installation.

When taking measurements in any of these situations, take them at both rakes because it is not unusual to find a difference of several inches between rakes on the same roof. By having this information before new shingles are applied, the applicator can compensate for the difference in small increments over a series of courses.

(C) Asphalt Shingles Over Old Asphalt Shingles

Inspect the existing roof for loose, curled, lifted or broken shingles, all of which should either be removed or nailed down.

Replace all missing shingles with new ones to provide an unbroken nailing base and to eliminate bridging in the new shingles. Buckled shingles usually indicate warped decking or protruding nails. Renail warped decking. Hammer down all loose or protruding nails or remove them and fasten the shingle down in a new location. Remove all badly worn drip edges and replace them with new ones. Sweep the surface clean before applying new roofing.

If existing asphalt shingles are the interlocking type, the size and shape of the shingles may result in an uneven surface. If a smoother base surface is desired, remove the old shingles and prepare the deck accordingly.

Deck Preparation

(continued)

Ⓓ Asphalt Shingles Over Old Wood Shingles

Remove all loose or protruding nails and renail the shingles. Nail down any loose, split, badly curled or warped shingles and renail the segments. Replace any missing shingles (do not use the same nail holes for renailing the shingles).

If shingles and trim at the eaves and rakes are badly weathered and subject to high winds, cut back the shingles at both locations far enough to install an edging strip. The edging should be a 1" x 4" to 1" x 6" board nailed firmly in place with the outside edge projecting beyond the deck the same distance as did the wood shingles. Install drip edges and eaves flashing (as required).

Many wood shingles provide a smooth fastening surface and no further preparation is necessary although some local codes may require the use of a No. 30 felt underlayment. If an old wood roof does not provide a desirable fastening surface but is still in fairly good condition, it can be improved with feathering strips placed along the butts of each course of old shingles. The 1" x 4" or 1" x 6" wood strips are beveled at the lower edge to meet the roof surface smoothly between each course of shingles. Install new sheet metal step flashing, as needed.

Ⓔ Asphalt Shingles Over Old Roll Roofing

After determining that the slope is suitable for the application of shingles, slit any buckles or blisters in the existing roll roofing. Press the segments flat against the deck and fasten them down to provide a smooth surface.

Remove loose or protruding nails and place new fasteners nearby. Fasten down any lap joints that have separated completely or in part. Trim old roofing that has been torn or damaged to square or rectangular sides. Inspect the underlying deck for knots or resinous areas which should be covered with sheet metal patches in the same manner as new construction. Patch the tear in the roofing with a new piece of roofing the same size as the trimmed area and nail the patch in place. Sweep the deck clean before applying new shingles.

Ⓕ Asphalt Shingles Over Old Slate Roofs

It is generally recommended that old slate roofs be removed before applying new asphalt shingles, although it is possible to apply asphalt shingles successfully over this type of substrate by following the general recommendations described below as well as those suggested by the individual shingle manufacturer.

First, consider the following conditions which must be met to make this type of reroofing feasible: (1) the old roof slates must not be thicker than 3/16" [Commercial Standard Slate], (2) the roof deck must be solidly sheathed and in good condition, and (3) the slates must not shatter when nails are driven — no matter where the placement. After years of exposure, most slates will have become quite soft and will receive needlepoint nails with very little breakage or spalling.

Begin by nailing down or removing any loose or projecting slates to provide a smooth surface for new roofing. The nails, used for shingle application, must be long enough to pass through the slates and penetrate the roof deck.

[Note]
Failure to follow these general application recommendations, especially those of the shingle manufacturer, may result in a poor roofing installation. Local building codes must be referred to for applicability and requirements regarding asphalt shingle applications over old slate roofs.

Ⓒ Asphalt Shingles Over Old Built-Up Roofs

Built-up roofing on a slopes ranging from 2" to 4" per foot may be reroofed with asphalt shingles provided no insulation exists between the deck and the felts. Remove any old slag, gravel or other material that is in place, leaving the surface of the underlying felts smooth and clean. (If a smooth, clean surface cannot be obtained, remove all of the old roofing and follow the procedures for reroofing when existing roofing is removed.) Apply the asphalt shingles directly over the felts in the same manner as that for new construction on low slopes.

If rigid insulation exists under the built-up roof, remove the built-up roof and the insulation to expose the underlying deck. Then follow the low slope application procedures outlined in Chapter 8.

Underlayment

If the old roofing has been removed, cover the deck with new asphalt felt underlayment in the same manner as new construction. If the old roofing is not removed and new shingles will be applied directly over the existing material, no additional underlayment is generally required because the old roofing serves the same purpose as the underlayment. However, some local codes may require the use of a No. 30 asphalt saturated felt as an underlayment when reroofing over old wood shingles.

Eaves Flashing (Ice Dams/Pine Needles/Leaves)

If reroofing over an existing roof where new eaves flashing is required to protect against ice dams (the continual thawing and freezing of snow and/or the backing up of frozen slush in gutters), remove the old roofing to a point at least 24" beyond the interior wall line and follow the severe icing application instructions described on page 43 for a normal slope or page 63 for a low slope.

Starter and Succeeding Courses

How the shingles are applied depends on whether the existing roofing has been removed or left in place and on the type of roofing material left in place.

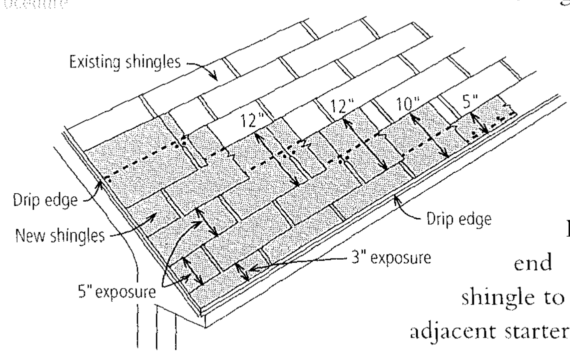
If the old roofing has been removed or if reroofing over old roll roofing or built-up roofing, the shingle application procedures are the same as those for new construction. Wood shingle roofs that are modified by feathering strips also are shingled in the same manner as new construction.

The situation that differs from new construction is the application of new strip shingles over existing strip shingles. The nesting procedure, described below, minimizes any unevenness that might result from the shingles bridging over the butts of the old shingles. It also ensures that the new horizontal fastening pattern is 2" below the old one. The nesting procedure, illustrated in Figure 54, is based on the assumptions that the new roofing has a 5" exposure and the existing roofing has been installed with a 5" exposure and properly aligned. If new eaves flashing has been added, snap chalk lines on it to guide the installation of the new shingles until the courses butt against the existing courses.

Ⓐ Starter Strip

Remove the tabs plus 2" or more from the top of the starter strip shingles so that the remaining portion is equal in width to the exposure of the old shingles (normally 5"). Apply the starter strip so that it is even with the existing roof at the eaves. If self-sealing shingles are used for the strip, locate the factory-applied adhesive along the eaves. Be sure the existing shingles overhang the eaves far enough to carry water into the gutter. If they do not, cut the starter strip to a width that will. Do not overlap the existing course above. Remove 3" from the rake end of the first starter strip shingle to ensure that joints between adjacent starter strip shingles will be covered when the first course is applied.

Figure 54
Application of new asphalt shingles over existing asphalt shingles using the nesting procedure



Ⓑ First Course

Cut 2" or more from the butts of the first course of shingles so that the shingles fit between the butts of the existing third course and the eaves edge of the new starter strip. Start at the rake with a full-length shingle. Use four fasteners per shingle, locating them in the same positions as in new construction (⅝" above the cutouts and 1" and 12" in from the sides). Do not fasten into or above the factory-applied adhesive.

Ⓑ Second and Succeeding Courses

Use full-width shingles. Remove 6" from the rake end of the first shingle in each succeeding course, through the sixth. Repeat the cycle by starting the seventh course with a full length shingle. If the alignment of the existing shingles is acceptable, simply place the top edge of the new shingles against the butt edge of the old shingles in the course above. The full-width shingles used on the second course will reduce the exposure of the first course to 3" but this area is usually concealed by gutters and the appearance should not be objectionable. For the remaining courses, the 5" exposure is automatic, coinciding with that of the existing shingles. As in new construction, apply the shingles across and then diagonally up the roof.

Flashing

The old roofing has been removed, flashing details generally follow those for new construction. However, if the existing flashings are still serviceable, they may be left in place and reused. If the old roofing is left in place, some flashing application details may differ from those for new construction. These are discussed in the following sections.

Ⓐ Valley Flashing

If the existing roof has an open valley, build up the exposed area of the valley with a mineral surfaced roll roofing (e.g., No. 90) to a level flush with the existing roofing. Then install new open valley flashing in the same manner as new construction, overlapping the existing shingles. The preferred treatment, however, is to construct a woven or closed cut valley with the new shingles crossing over the valley filler strip.

Ⓑ Flashing Against A Vertical Sidewall: Asphalt Shingles Over Old Asphalt Shingles

Continue aligning the top edge of the new shingles against the butt edge of the existing shingles. Trim the new shingles to within ¼" of the existing step flashing. Embed the last 3" of the end shingle in each course in asphalt plastic cement. Apply a bead of cement with caulking gun at the joint between the ends of the new shingles and the sidewall.

Ⓒ Flashing Against A Vertical Sidewall: Asphalt Shingles Over Old Wood Shingles

Place either a 6" to 8" wide strip of a smooth coated roll roofing (e.g., No. 50) or a mineral surfaced roll roofing upside down over the wood shingles that butt the wall surface. Fasten the strip along each side with the fasteners spaced 4" on

Flashing

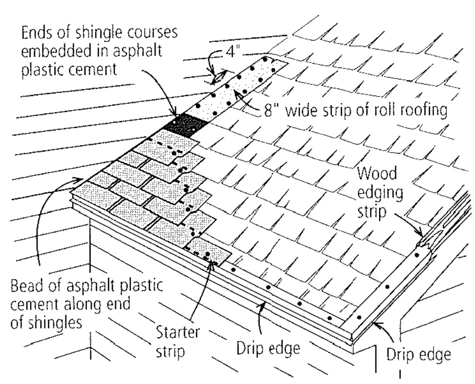
(continued)

center. Cover the flashing strip with a thin layer of asphalt plastic cement and embed the end shingle in each course firmly in it. Apply a bead of cement with a caulking gun at the joint between the ends of the new shingles and the sidewall. (See Figure 55.)

D Flashing Around Soil Stacks and Vent Pipes

Carefully examine the existing flashing around the pipe. If it has deteriorated, remove the old flashing and apply a new one following the procedure described for soil stack and vent pipe flashing in Chapter 7.

Figure 55
Flashing against a vertical wall when reroofing over wood shingles



If the existing flashing is in good condition, lift the lower part of the flange and install new shingles beneath it. (A heated putty knife will help separate the cement flange from the existing roof.) Cover the area under the flange with asphalt plastic cement and set the flange back in place. Apply additional cement around the outside of the pipe to protect the joint between the pipe and the flange. Resume applying shingles up the roof. Cut shingles in successive courses to fit snugly around the pipe and embed them in asphalt plastic cement. Do not drive any fasteners close to the pipe.

E Flashing Around Chimneys

Carefully examine the existing flashings around the chimney. If the flashings have deteriorated or if the chimney does not have a cricket, remove the affected flashings and roofing and follow the procedure described in Chapter 7 for flashing around chimneys.

If the existing flashings are in good condition, lift the lower part of the front base flashing and install new shingles beneath it. Cover the area under the flashing with asphalt plastic cement and set the flashing back in place.

At the sides of the chimney, trim the new shingles to within ¼" of the existing step flashing. Embed the last 3" of each end shingle in a thin layer of asphalt plastic cement and apply a bead of cement with a caulking gun at the joint between the ends of the new shingles and the flashings.

If the existing cricket flashing is metal, apply new shingles up to the flashing and set the last 3" of each end shingle in cement. If the existing cricket has been shingled, treat as in the section on "Valley Flashing" discussed earlier in this chapter.

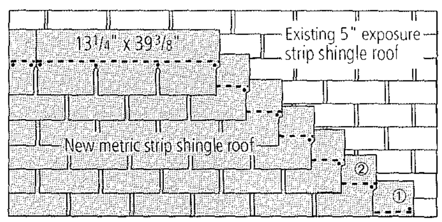
Hips and Ridges

If the old roofing has been removed, apply hip and ridge shingles in the same manner as new construction. If the existing roofing has been left in place, the old hip and ridge shingles should be removed in order to obtain a level application and better fastener anchorage. After the existing hip and ridge shingles have been removed, finish the roof at the hips and ridges in the same manner as new construction.

Metric Shingles

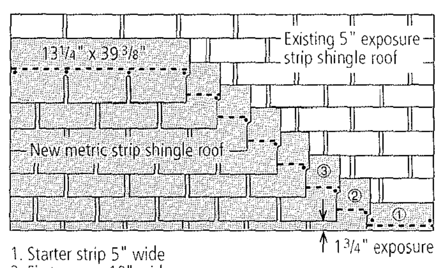
If old asphalt shingles with a 5" exposure are to be covered with metric-size shingles, either a "bridging" or a "nesting" procedure is acceptable. Either will provide good results when properly applied. The bridging method shown in Figure 56 requires fewer shingles than the nesting procedure illustrated in Figure 57. However, telegraphing of the underlying material may result when the bridging method is used. Nesting, which minimizes an uneven appearance that can be caused by the underlying material, may also be used when applying metric-size shingles over an existing roof of metric shingles. (See Figure 58.) For specific recommendations regarding bridging or nesting, contact the shingle manufacturer.

Figure 56
Bridging application of metric strip shingles over 5" exposure 3-tab shingles



1. Starter strip 7 5/8" wide (tabs cut from shingle)
2. First and succeeding courses consisting of full-width shingles

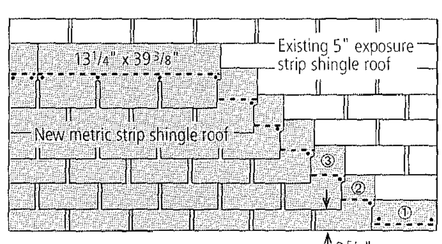
Figure 57
Nesting application of metric strip shingles over 5" exposure 3-tab shingles



1. Starter strip 5" wide
2. First course 10" wide
3. Second and succeeding courses full-width shingles

Note: Exposure first course 1 3/4"; All other courses 5" exposure

Figure 58
Nesting application of metric strip shingles over 5 5/8" exposure 3-tab shingles



1. Starter strip 5 5/8" wide
2. First course 11 1/4" wide
3. Second and succeeding courses full-width shingles

Note: Exposure first course 3 5/8"; All other courses 5 5/8" exposure

chapter notes

Application of Individual Shingles

Individual shingles are manufactured in three basic types: hexagonal, giant and interlocking. Selection depends on many factors, including slope, wind resistance, coverage, aesthetics and economics. Installation details vary according to the type of shingle used.

Preparation Procedure

Regardless of the type of individual shingle used on new construction, preparatory procedures are the same as those for applying strip shingles. Inspect the structure to determine if it is adequately ventilated. Cover the deck with an asphalt saturated felt underlayment. Snap horizontal and vertical chalk lines. Install drip edges, eaves flashings (if required) and valley flashings.

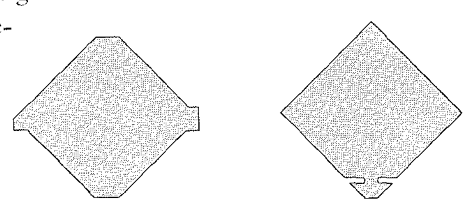
When individual shingles are used for reroofing, make the same preparations as those for reroofing with strip shingles. Evaluate the condition of the existing roof to determine whether the old material may remain in place. Perform remedial work on the deck if the old roofing is removed or on the existing roofing if it remains in place. Install flashings as required.

Application

Ⓐ Hexagonal Shingles

Two types of hexagonal shingles are available: those that are locked together by a clip and those that have a built-in locking tab. (See Figure 59.) Both the clip-down and lock-down shingles are relatively lightweight and intended primarily for reroofing over old roofing. They may also be used at times for new construction. For either application, the slope should be 4" per foot or greater. Consult the roofing manufacturer for specific application instructions.

Figure 59
Individual hexagonal shingles

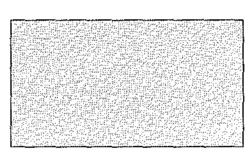


Typical clip-down shingle — Typical lock-down shingle

Ⓑ Giant Shingles

This type of shingle, shown in Figure 60, may be used for new construction or reroofing depending on the method of application:

Figure 60
Giant individual shingle



Application
(continued)

① *Dutch Lap Method*

This method is intended primarily for reroofing over old roofing that provides a smooth surface and adequate anchorage for nailing. It may also be used to cover new decks where single coverage will provide the intended protection. For either application, the slope should be 4" per foot or greater. Consult the roofing manufacturer for specific application instructions.

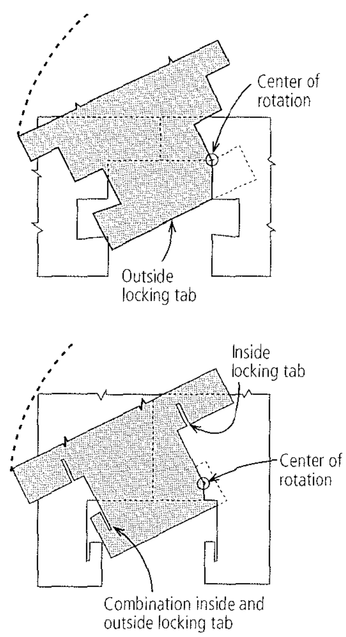
② *American Method*

This method of application may be used for new construction or reroofing. In either case, the slope should be 4" per foot or greater. Consult the roofing manufacturer for specific application instructions.

Ⓒ Interlocking Shingles

Interlocking shingles are manufactured with an integral locking device that provides immediate wind resistance. The shingles may be used for reroofing over existing roofing on slopes recommended by the shingle manufacturer. They may also be used for new construction depending on whether single or double coverage is required. In general, single coverage interlocking shingles are not recommended for new construction. Check local building codes before applying them on new roofs.

Figure 61
Common interlocking shingles and their methods of locking



The location of fasteners on the shingle is essential to proper performance of the mechanical interlock. For best results, follow the shingle manufacturer's specifications concerning fastener placement. Also follow the manufacturer's directions concerning application of the starter, first and succeeding courses.

Although interlocking shingles are self-aligning, they are flexible enough to allow limited movement for adjustment. Thus, it is especially important to snap horizontal and vertical chalk lines to keep the work in alignment.

The integral locking tabs are manufactured within close tolerances to ensure a definite space relationship between adjacent shingles. Be sure, therefore, to engage the locking devices carefully and correctly. Figure 61 illustrates two common locking devices used in interlocking shingles.

During installation, locking tabs on shingles along the rakes and eaves may have to be removed in part or entirely. To prevent wind damage, shingles that have their locking tabs removed should either be cemented down or fastened in place according to the individual manufacturer's recommendations.

Application of Roll Roofing

Asphalt roll roofing is typically manufactured in 36" wide sheets and comes in a variety of weights, surfacings and colors. It is used both as a primary roof covering and a flashing material.

When maximum service life is an important consideration, use the concealed nail method of application. As a primary roof covering, roll roofing is used on slopes down to 2" per foot. The roofing is applied either parallel to the eaves or parallel to the rakes. The type of nail shall fit the application and have a length sufficient to penetrate ¾" into the deck or through the deck panel.

Store the material in a warm place on end until ready for use, especially during the colder seasons of the year. It is not good practice to apply roll roofing when the temperature is below 45°F. If rolls are handled below this temperature and have not been stored as suggested, warm them before unrolling to avoid cracking the coating. Then cut the rolls into 12' to 18' lengths and spread them in a pile on a smooth surface until they flatten out.

Before applying roll roofing, prepare the deck and install the necessary flashing in the same manner as described in Chapter 7 for strip shingles. Valleys will be the open type, so follow the appropriate valley flashing procedures.

Because all roll roofing is applied with a certain amount of top and side lapping, proper sealing of the laps is critical. Use only the lap cement recommended by the roofing manufacturer. Store the cement in a warm place until ready to use. The lap cement is asphalt based and contains solvents, therefore, take proper safety precautions. Never heat lap cement directly over a flame. Do not attempt to thin the cement by diluting it with solvent.

[Warning]

Excessive amounts of cement may cause blistering of roll roofing. Allow sufficient time for volatiles to flash off.

On all cementing, apply the cement in a continuous but not excessive layer over the full width of the lap.

Press the lower edge of the upper course firmly into the cement until a small bead appears along the edge of the sheet. Using a roller, apply pressure uniformly over the entire cement area. Unless otherwise noted by the roofing manufacturer, apply lap cement conforming to ASTM D 3019 at the rate specified by the coating manufacturer.

Application Parallel to the Eaves

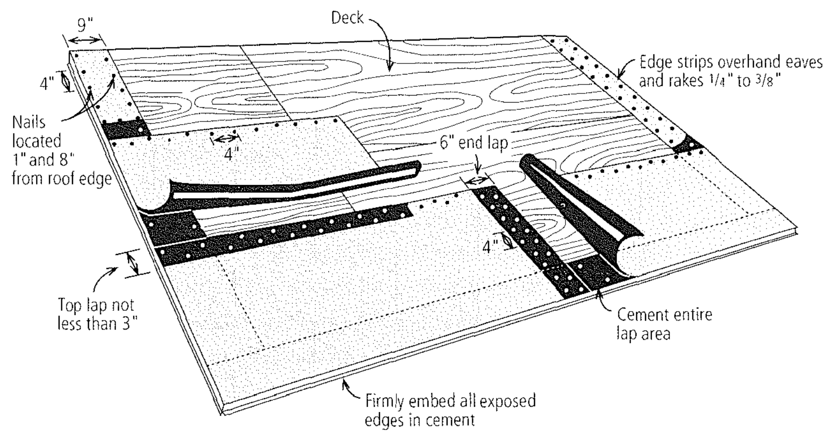
Ⓐ Concealed Nail Method (Slopes of 1" Per Foot or Greater)

When using this method, narrow edging strips are placed along the eaves and rakes before applying the roofing. Figure 62 illustrates the general installation procedure, including lapping, cement and nailing.

① *Edge Strips*

Place 9" wide strips of roll roofing along the eaves and rakes, positioning them to overhang the deck ¼" to ⅜". Fasten the strips with rows of nails located 1" and 8" from the roof edge and spaced 4" on center in each row.

Figure 62
Concealed nail method of applying roll roofing parallel to the eaves



② *First Course*

Position a full-width strip of roll roofing so that its lower edge and ends are flush with the edge strips at the eaves and rakes. Fasten the upper edge with nails 4" on center and slightly staggered. Locate the nails so that the next course will overlap them a minimum of 1". Lift the lower edge of the first course and cover the edge strips with cement according to the manufacturer's specifications. In cold weather, turn the course back carefully to avoid damaging the roofing material. Press the lower edge and rake ends of the first course firmly into the cement-covered edge strips. Work from one side of the sheet to the other to avoid wrinkling or bubbling.

End laps should be 6" wide and cemented over the full lap area with the recommended cement. Nail the underlying sheet in rows 1" and 5" from the end of the sheet with the nails spaced 4" on center and slightly staggered. End laps in succeeding courses must not line up with one another.

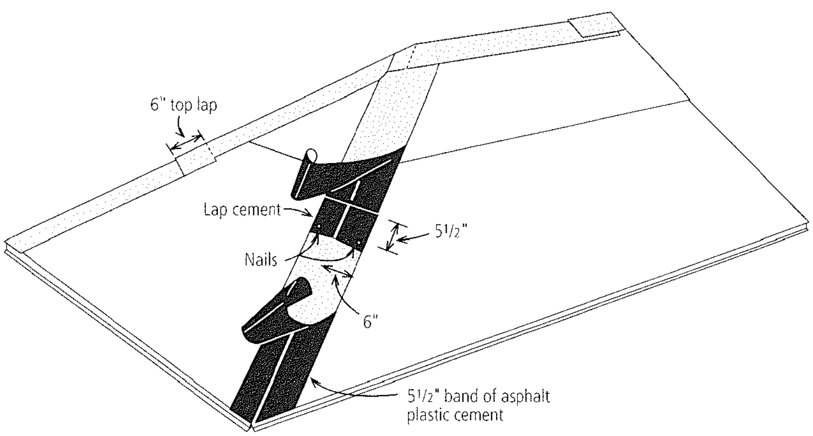
③ ***Second and Succeeding Courses***

Position the second course so that it overlaps the first course at least 3" or as specified by the roofing manufacturer. Fasten the upper edge to the deck, cement the laps and finish installing the sheet in the same manner as the first course. Follow the same procedure for each successive course. Do not apply nails within 18" of the rake until cement has been applied to the edge strip and the overlying strip has been pressed down.

④ ***Hips and Ridges***

Trim, butt and nail the sheets as they meet at a hip or ridge. Next, cut 12" x 36" strips from the roll roofing and bend them lengthwise to lay 6" one each side of the joint. Do not bend the strips in cold weather without first warming them. These will be used as "shingles" to cover the joint, each one overlapping the other by 6" as shown in Figure 63.

Figure 63
Concealed nail method of applying roll roofing at the hips and ridges



Start hips at the bottom and ridges at the end opposite the direction of the prevailing winds. To guide the installation, snap a chalk line 5½" from and parallel to the joint on both sides. Apply asphalt plastic cement evenly over the entire area between chalk lines from one side of the joint to the other. Fit the first folded strip over the joint and press it firmly into the cement, driving two nails 5½" from the edge of the end that will be lapped. Cover the 6" lap on this strip with lap cement. Then place the next strip over it. Nail and cement in the same manner as the first strip. Continue the same procedure until the hip or ridge is finished.

Application Parallel to the Eaves

(continued)

Exposed Nail Method (Slopes of 2" Per Foot or Greater)

Figure 64 illustrates the general installation procedures, including lapping, cementing and nailing.

① *First Course*

Position a full-width sheet so that its lower edge and ends overhang the eaves and rakes between ¼" and ⅜". Nail along a line ½" to ¾" parallel to the top edge of the sheet, spacing the nails 18" to 20" apart. This top nailing holds the sheet in place until the second course is placed over it and fastened. Nail the eaves and rakes on a line 1" parallel to the edges of the roofing with the nails spaced 3" on center and staggered a bit along the eaves to avoid splitting the deck.

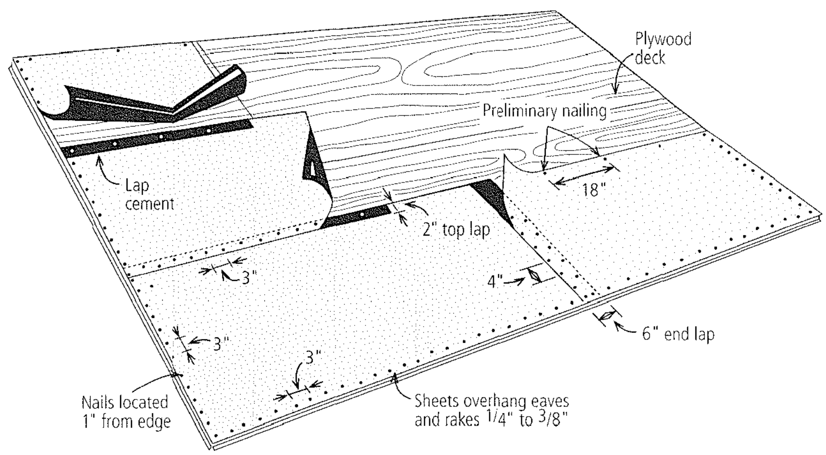


Figure 64
Exposed nail method of applying roll roofing parallel to the eaves

If two or more sheets must be used to continue the course, lap them 6". Apply lap cement to the underlying edge over the full lap width. Embed the overlapping sheet into it and fasten the overlap with two rows of nails 4" apart and 4" on center within each row. Stagger the rows so that the spacing is 2" between successive nails from row to row.

② *Second and Succeeding Courses*

Position the second course so that it overlaps the first course by 2". Fasten the second course along the top edge following the same nailing directions as the first course. Lift the lower edge of the overlapping sheet and apply lap cement evenly over the upper 2" of the first course. Then embed the overlapping sheet into it. Fasten the lap with nails spaced 3" on center and staggered slightly. Place the nails not less than ¾" from the edge of the sheet. Nail the rake edges in the same manner as the first course. Follow the same procedure for each successive course. End laps should be 6" wide and cemented and nailed in the same manner as the first course. Stagger end laps so that an end lap in one course is never positioned over the end lap in the preceding course.

③ *Hips and Ridges*

Trim, butt and nail the roofing as it meets at a hip or ridge. Snap a chalk line on each side of the hip or ridge, located 5½" from the joint and parallel to it. Starting at the chalk lines and working toward the joint, spread a 2" wide band of asphalt lap cement on each side of the hip or ridge. (See Figure 65.)

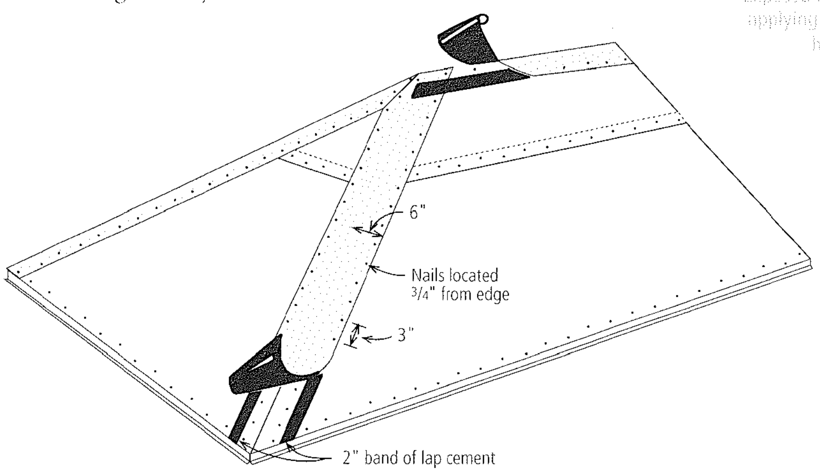


Figure 65
Exposed nail method of applying roll roofing to hips and ridges

Cut strips of roll roofing 12" wide and bend them lengthwise along the centerline so that they will lay 6" on each side of the hip or ridge. In cold weather, warm the roofing before bending it. Lay the bent strip over the joint and embed it in the cement. Fasten the strip to the deck with two rows of nails, one on each side of the hip or ridge. The rows should be located ¾" from the edges of the strip and the nails spaced 3" on center. Be sure the nails penetrate the cemented zone underneath which will seal the nail hole with asphalt. End laps should be 6" and cemented the full lap distance. Avoid excessive use of cement as it may cause blistering.

Application Parallel to the Rake

Ⓐ Concealed Nail Method (Slopes of 1" Per Foot or Greater)

With this method, illustrated in Figure 66, the sheets are applied vertically from the eaves up. Lay the sheets out and let them warm in the sun until they lie smoothly on a flat surface. If you nail the sheets before they have time to relax, wrinkling may occur.

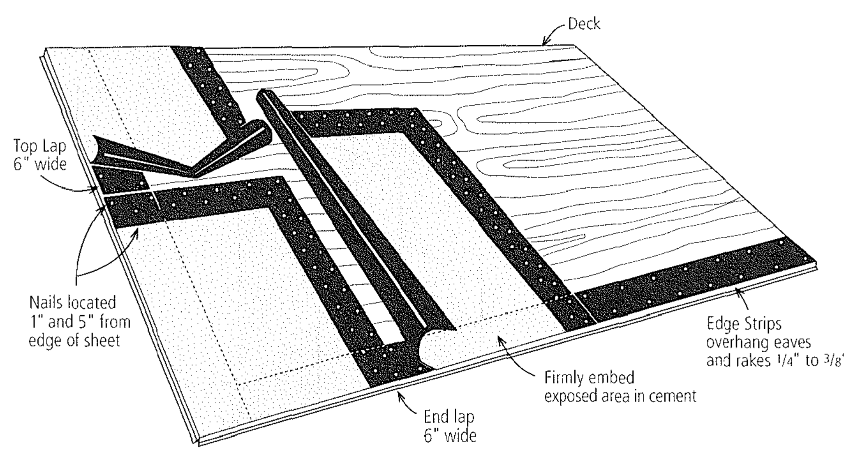
① *Edge Strips*

Place 9" wide strips of roll roofing along the eaves and rakes. Placement and nailing of these strips is identical to the description found in the concealed nail method for application parallel to the eaves.

② *First Course*

Position the first sheet so it is flush with the edge strips at the rake and eaves. Fasten the upper edge with nails located 1" and 5" from the top edge of the sheet with the

Figure 66
Concealed nail method of applying roll roofing parallel to the rake



nails spaced 4" on center. Carefully lift the first sheet back and cover both edge strips with an even layer of plastic cement. Remember that excessive amounts of plastic cement may cause blistering. Press the sheet firmly into the cement. Work from the top of the sheet down to avoid wrinkling or bubbling.

End laps should be a minimum of 6" wide. Fasten the length of the end lap with nails 4" on center and slightly staggered. Locate the nails so that the next sheet will overlap them a minimum of 1". End laps should be cemented over the full lap area with recommended lap cement.

Top laps should be a minimum of 6" wide. Stagger the top laps of adjoining sheets to prevent a buildup where the sheets intersect. End laps should be cemented over the full lap area with the recommended lap cement.

③ *Second and Succeeding Courses*

Position the second course so that it overlaps the first course at least 6". Fasten the upper edge to the deck, cement the laps and finish installing the sheet in the same manner as the first course. Do not apply nails within 18" of the rake until cement has been applied to the edge strip and overlying strip has been pressed down. Remember to apply all cement in a continuous, but not excessive, layer over the full width of the lap. Press the edge of the sheet into the cement until a small bead appears at the lap. Use a roller to apply uniform pressure over the entire cemented area.

④ *Hips and Ridges*

Finish the roof at these joints in the same manner as the concealed nail method of application parallel to the eaves.

chapter notes

Application of Double Coverage Roll Roofing

Double coverage roll roofing is a 36" wide sheet of which 17" are intended for exposure and 19" for a selvage edge. It provides double coverage for the roof and may be used on slopes down to 1" per foot.

The 17" exposed portion is covered with granules while the 19" selvage portion is finished in various manners depending on the manufacturer. Some saturate the selvage portion with asphalt; some saturate and coat it.

The selvage edge and all end laps should be cemented according to the manufacturer's recommendations. Thus, it is important to know the requirements of the particular product being used and follow the roofing manufacturer's directions concerning the type and quantity of adhesive. Unless otherwise noted by the roofing manufacturer, apply asphalt lap cement conforming to ASTM D 3019 at the rate of 1 gallon per 100 $ft.^2$ of covered area or as recommended by coating manufacturer.

Make certain there is adequate roof drainage to eliminate the possibility of water standing in puddles. This is especially important on the low slopes on which double coverage roofing is commonly used. Choose the correct type and length of nail to fit the application. The fastener should be able to penetrate the deck ¾" or through the deck panel.

Observe the same precautions concerning storage, application temperature and warming of the rolls as those described in Chapter 11 for single coverage roll roofing. Similarly, store asphalt cements in a warm place until ready for use.

Application of double coverage roll roofing may be parallel to the eaves or parallel to the rake. Although 19" selvage roll roofing is discussed here, any roll roofing may be applied in the same manner to obtain double coverage if the lapped portion of the sheet is 2" wider than the exposed portion.

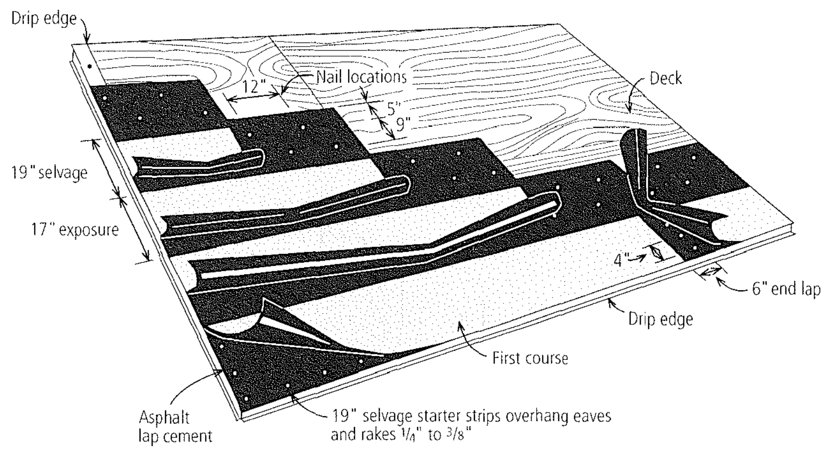
Before applying the roofing, prepare the deck and install flashings in the same manner as described in Chapter 7 for strip shingles. Valleys will be the open type, so follow the appropriate valley flashing procedures.

Application Parallel to the Eaves

Figure 67
Application of double coverage roll roofing parallel to the eaves

Starter Strip

Remove the 17" granule-surfaced portion from a sheet of double coverage roll roofing. Place the remaining 19" selvage portion parallel to the eaves so that it overhangs the drip edge ¼" to ⅜" at both the eaves and rakes. Fasten it to the deck with two rows of nails, one on a line 5" from the top edge of the strip, the other on a line 1" above the lower edge. Space the nails 12" on center, slightly staggering them in each row. (See Figure 67.)



First Course

Cover the entire starter strip with asphalt plastic cement. Avoid excessive use of cement as it may cause blistering. Then position a full-width sheet over it. Place the sheet so that the side and lower edge of the granule-surfaced portion are flush with the rake and eaves edges of the starter strip. Fasten it to the deck with two rows of nails in the selvage portion. Locate the first row 5" below the upper edge and the second row 9" below the first with the nails spaced 12" on center and staggered.

Succeeding Courses

Position each succeeding course so that it overlaps the full 19" selvage width of the course below and nail the selvage portion in the same manner as the first course. Carefully turn the granule portion of the sheet up and apply cement to the full selvage portion of the underlying sheet. Spread the cement to within ¼" of the edge of the exposed portion. Press the overlying sheet firmly into the cement. Apply pressure over the entire lap using a broom or light roller to ensure complete adhesion between the sheets. It is important to apply the cement so that it flows to the edge of the overlying sheet under the application pressure. Avoid excessive use of cement as it may cause blistering. Follow the roofing manufacturer's recommendations.

End Laps

All end laps should be 6" wide. Fasten the underlying granule-surfaced portion of the lap to the deck with a row of nails 1" from the edge. Space the nails 4" on center. Then spread asphalt plastic cement evenly over the lap area. Embed the overlying sheet in the cement and secure the selvage portion of the sheet to the deck with nails on 4" centers in a line 1" from the edge of the lap. Stagger all end laps so that those in successive courses do not line up with one another.

[Caution]

Never cement roll roofing directly to the deck. This will ensure that the sheets do not split due to deck movement. To make certain that roll roofing is not cemented to the deck when hot application is allowed, nail down a base sheet.

Application Parallel to the Rake

With this method, the sheets are applied vertically from the ridge down. Begin by applying starter strips to both rakes using the same procedures as in horizontal application. Cover the starter strip with lap cement and apply a full-width sheet over it as the first course. Position all end laps so that the upper sheet overlies the lower one, thereby carrying drainage over the joint rather than into it. The remainder of the application is then the same as that for parallel to the eaves. Figure 68 shows the general arrangement for application parallel to the rake.

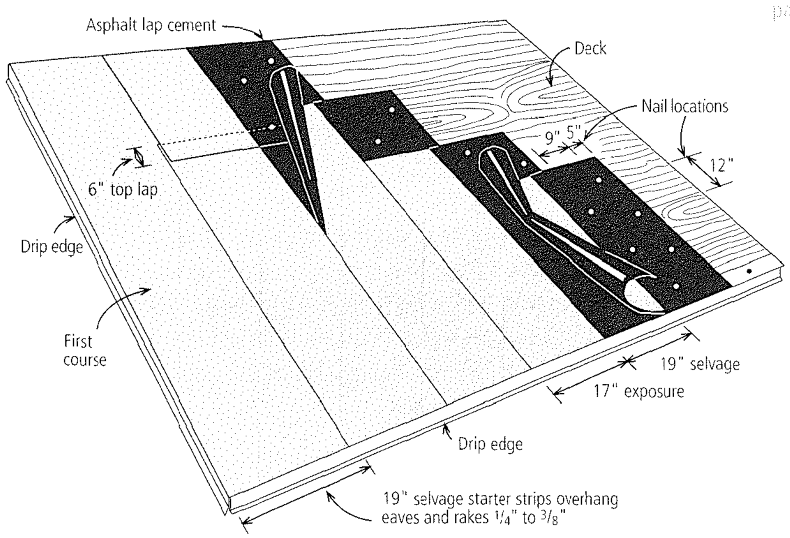


Figure 68
Application of double coverage roll roofing parallel to the rake

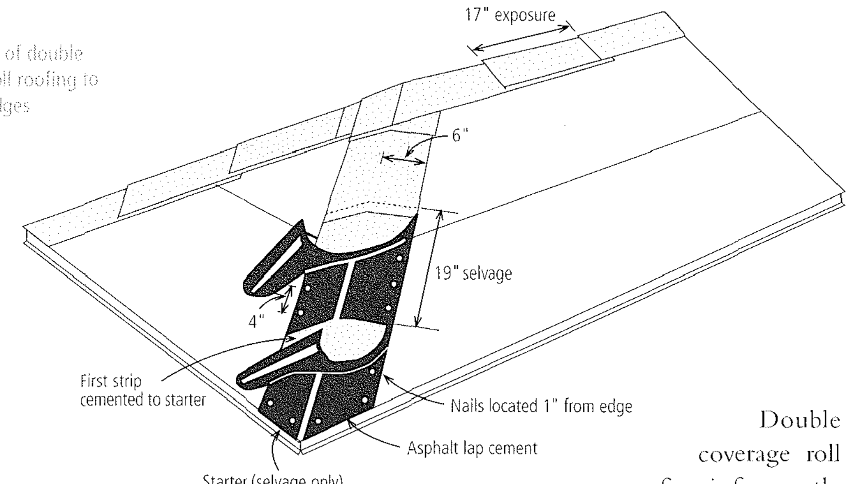
Hips and Ridges

For both applications, trim, butt and nail the roofing sheets as they meet at a hip or ridge. Snap chalk lines 5½" from and parallel to the joint on each side to guide the installation.

Next, cut 12" x 36" strips of roll roofing that include the selvage portion. Bend the strips lengthwise to lie 6" on either side of the joint. In cold weather, be sure to warm the strips before bending. Start applying the strips at the lower end of the hip or at the end of the ridge opposite the direction of prevailing winds.

Cut the selvage portion from one strip to use as a starter. Fasten this strip in place by driving nails 1" from each edge and 4" on center over the full length. Cover it completely with asphalt plastic cement. Fit the next folded strip over the starter and press it firmly into the cement, nailing it in the same manner as the starter but only in the selvage portion. Continue the process until the hip or ridge is completed. Figure 69 illustrates the procedure.

Figure 69
Application of double coverage roll roofing to hips and ridges



Double coverage roll roofing is frequently used on sheds which contain no hips or ridges. To finish this type of roof, trim and nail the selvage portion of the last course to the edge of the roof. Then trim the exposed, granule-surfaced portion that had been cut from the starter strip to fit over the final selvage portion and cement it in place. Finally, overlay the entire edge with metal flashing and cement it in place.

Inspection of the Completed Job

A quality installation is dependent on roof inspections during application in addition to the final roof inspection upon completion. It offers the applicator a number of opportunities to make certain that the materials are properly placed, properly fastened and in good condition.

Upon final inspection, give the roof one last cleaning. Remove any loose shingles, cuttings, nails, wood shavings, boards or other debris that has been left lying on the roof. Remove any debris from valleys and gutters to ensure that they are unobstructed and will carry water away quickly and efficiently.

Damaged shingles cause leaks and detract from the appearance of the finished job. So be sure to inspect the finished roof for any broken, torn or damaged shingles. Remove damaged shingles by drawing the fasteners from the damaged shingle and the one immediately above it. Carefully fit a new shingle into place, fasten and hand seal both shingles.

Inspect all areas on which asphalt cements have been used to ensure that the materials have adhered properly and there are no bubbles in the roofing. If re-cementing is required to obtain a good bond, carefully lift the overlying material to avoid damaging it, apply the cement and work it thoroughly into the material. Replace the overlying layer, pressing it firmly into the cement.

Regardless of the type of asphalt roofing material used, check for proper fastening. Fasteners should not be exposed unless the installation procedures specifically call for exposure. No fasteners should protrude from or be driven into the surface of the roofing material. Seat all protruding fasteners if they are otherwise improperly placed. If a protruding fastener must be driven properly or replaced, remove any bent or incorrectly placed fasteners as well as any that are driven too far into the surface of the asphalt roofing. Then pack the hole with asphalt plastic cement and drive a new fastener nearby.

Before leaving the roof, examine the entire roof area for overall appearance and any defects that might have been overlooked at closer range.

Remove scaffolding and ladders carefully to avoid scraping the siding, breaking windows, breaking tree branches or damaging shrubbery.

Thoroughly clean the site of roofing materials, cuttings, scraps, wood and any other debris remaining from the roofing work. If possible, before leaving the job, have the owner make a final inspection of the grounds and obtain his approval of the work.

Shading

As a completed asphalt shingle roof is viewed from different angles, certain areas may appear darker or lighter. This difference in appearance is called shading. Shading also depends on the position of the sun and the overall intensity of light. For example, slanting sun rays emphasize shading, while direct, overhead rays cause color shading to disappear.

Shading is a visual phenomenon that in no way affects the performance of the shingles. It occurs primarily as a result of normal manufacturing operations that produce slight differences in surface texture that cannot be detected during the production process. These unavoidable variations in texture simply affect the way the surface reflects light.

Shading is usually more noticeable on black or dark-colored shingles because they reflect only a small part of the light shining on them, magnifying the slight differences in surface texture. White and light-colored shingles reflect a great amount of light, diminishing observable shading differences. Blends made from a variety of colors actually tend to camouflage shading, with lighter colored blends reducing the effect of shading more than darker blends.

"Racking" or straight-up application accentuates shading. For this reason, be sure shingles are applied across and diagonally up the roof. This blends shingles from one bundle into the next, minimizing any shade variation from one bundle to the next.

Shading may also occur when the backing material used to keep shingles from sticking together in the bundle rubs off onto the exposed portion of a shingle. Staining may also appear in shingles that have been stacked too high or over too long a period of time. This type of shading develops because of minor staining from the oils contained in the asphalt coating. In either of these cases, natural weathering will usually eliminate the problem over a period of time.

Roof Care and Maintenance

Properly installed asphalt roofing products will provide years of protection. Even so, there are certain aspects of roof care such as those listed below that the owner should be made aware of to ensure maximum roof performance.

Never paint or coat asphalt roofing to change its color or give the roof a "new" look. The use of paint or coatings may void the manufacturer's warranty. Consult the individual manufacturer.

Keep gutters and roof surfaces clear of fallen leaves, pine needles, twigs and other litter so that water will drain freely.

Never allow water from a downspout to pour directly onto a roof below. Connect an upper story downspout to a lower level gutter with drains installed on the lower roof.

Keep trees trimmed to prevent branches from scuffing the roof surface. Keep climbing roses, vines and ivy trimmed back from the roof.

When removing snow or ice from a valley or other roof area, do it carefully to avoid damaging the roof. For safety, use a broom or long extension pole. Never climb onto a wet or snow-covered roof.

Make annual inspections of the roof to evaluate its general condition and detect any potential leakage problems before they develop. The best time for an inspection is the spring after severe weather conditions (and the damage they may have inflicted) have passed. In addition, the weather is ideal for repairs if they are necessary.

Inspect the underside of the roof deck from the attic to detect leaks. Flashings are the most vulnerable points. Therefore, inspect the underside carefully at all flashing points for evidence of leakage such as water stains. Remember that in cooler climates, water stains may be due to condensation as a result of inadequate attic ventilation.

Where problems are identified, call in a competent roofer to make an actual on-roof inspection and any repairs that are necessary.

Limit walking on roofs to a minimum to avoid damaging the surface. When workmen have to climb onto the roof to service or install a chimney, solar collector, television antenna or other roof element, require them to use care to protect the roofing.

Whenever a new element is added to the roof, make certain proper flashing procedures are followed to maintain the integrity of the roofing. Be sure anchors are made of a noncorrosive material to eliminate the possibility of metal discoloration or "iron staining" on the roof.

Algae Discoloration

A type of roof discoloration caused by algae and commonly referred to as "fungus growth" is a frequent problem throughout the country. It is often mistaken for soot, dirt, moss or tree droppings.

The algae that cause this discoloration do not feed on the roofing material and, therefore, do not affect the service life of the roofing. However, the natural pigments in the algae may gradually turn a white or light roof dark brown or black over a period of years.

Algae discoloration is difficult to remove from roofing surfaces but it may be lightened with a diluted cleaning solution. (Contact the appropriate manufacturer for details). Sponge the solution on the roofing gently; scrubbing will loosen and remove granules. Apply the solution carefully to avoid damaging other parts of the building and/or the surrounding landscape. If possible, work from a ladder or walkboards to avoid walking directly on the roof surface. Observe safety precautions whenever working on or near the roof. After sponging, rinse the solution off the roof with a hose.

[Caution]

This process will make the roof slippery and potentially hazardous during treatment.

The effectiveness of such cleaning is only temporary and the discoloration may recur. However, several types of algae resistant roofing have been developed and are now commercially available. These asphalt roofing products are specifically designed to inhibit most algae growth for extended periods of time.

Glossary

Algae Discoloration: A type of roof discoloration caused by algae. Commonly called fungus growth.

American Method: Application of giant individual shingles with the long dimension parallel to the rake. Shingles are applied with a ¾" space between adjacent shingles in a course.

ASTM: American Society for Testing and Materials. A voluntary organization concerned with development of consensus standards, testing procedures and specifications.

Asphalt: A bituminous waterproofing agent applied to roofing materials during manufacture.

Asphalt Roofing Cement: An asphalt-based cement used to bond roofing materials. Also known as flashing cement or mastic; should conform to ASTM D 4586 (Asbestos Free) or ASTM D 2822 (Asbestos Containing).

Back Surfacing: Fine mineral matter applied to the back side of shingles to keep them from sticking together.

Base Flashing: That portion of the flashing attached to or resting on the deck to direct the flow of water onto the roof covering.

Blisters: Bubbles that may appear on the surface of asphalt roofing after installation.

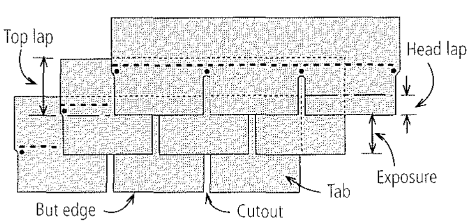
Brands: Airborne burning embers released from a fire.

Bridging: A method of reroofing with metric-sized shingles.

Built-Up Roof: A flat or low-sloped roof consisting of multiple layers of asphalt and ply sheets.

Bundle: A package of shingles. There are typically 3, 4 or 5 bundles per square.

Figure A
Shingle specifications



Butt edge: The lower edge of the shingle tabs. (See Figure A.)

Caulk: To fill a joint with mastic or asphalt cement to prevent leaks.

Cement: See Asphalt Plastic Roofing Cement.

Chalk Line: A line made on the roof by snapping a taut string or cord dusted with chalk. Used for alignment purposes.

Class "A": The highest fire-resistance rating for roofing as per ASTM E 108. Indicates roofing is able to withstand severe exposure to fire originating from sources outside the building.

Class "B": Fire-resistance rating that indicates roofing materials is able to withstand moderate exposure to fire originating from sources outside the building.

Class "C": Fire-resistance rating that indicates roofing material is able to withstand light exposure to fire originating from sources outside the building.

Closed Cut Valley: A method of valley treatment in which shingles from one side of the valley extend across the valley while shingles from the other side are trimmed 2" from the valley centerline. The valley flashing is not exposed.

Coating: A layer of viscous asphalt applied to the base material into which granules or other surfacing is embedded.

Collar: Pre-formed flange placed over a vent pipe to seal the roof around the vent pipe opening. Also called a vent sleeve.

Concealed Nail Method: Application of roll roofing in which all nails are driven into the underlying course of roofing and covered by a cemented, overlapping course. Nails are not exposed to the weather.

Condensation: The change of water from vapor to liquid when warm, moisture-laden air comes in contact with a cold surface.

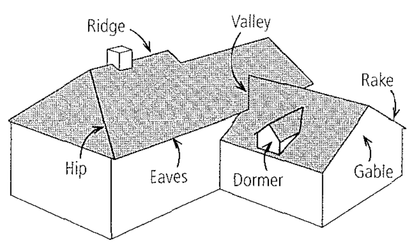
Counter Flashing: That portion of the flashing attached to a vertical surface to prevent water from migrating behind the base flashing.

Course: A row of shingles or roll roofing running the length of the roof.

Coverage: Amount of weather protection provided by the roofing material. Depends on number of layers of material between the exposed surface of the roofing and the deck; i.e., single coverage, double coverage, etc.

Cricket: A peaked saddle construction at the back of a chimney to prevent accumulation of snow and ice and to deflect water around the chimney.

Figure B
Basic roof elements



Cutout: The open portions of a strip shingle between the tabs. (See Figure A.)

Deck: The surface, installed over the supporting framing members, to which the roofing is applied.

Dormer: A framed window unit projecting through the sloping plane of a roof. (See Figure B.)

Double Coverage: Application of asphalt roofing such that the lapped portion is at least 2" wider than the exposed portion, resulting in two layers of roofing material over the deck.

Downspout: A pipe for draining water from roof gutters. Also called a leader.

Drip Edge: A non-corrosive, non-staining material used along the eaves and rakes to allow water run-off to drip clear of underlying construction.

Dutch Lap Method: Application of giant individual shingles with the long dimension parallel to the eaves. Shingles are applied to overlap adjacent shingles in each course as well as the course below.

Eaves: The horizontal, lower edge of a sloped roof. (See Figure B.)

Eaves Flashing: Additional layer of roofing material applied at the eaves to help prevent damage from water back-up.

Edging strips: Boards nailed along eaves and rakes after cutting back existing wood shingles to provide secure edges for reroofing with asphalt shingles.

Ell: An extension of a building at right angles to its length.

Exposed Nail Method: Application of roll roofing in which all nails are driven into the cemented, overlapping course of roofing. Nails are exposed to the weather.

Exposure: That portion of the roofing exposed to the weather after installation. (See Figure A.)

Exposure I Grade Plywood: Type of plywood approved by the American Plywood Association for exterior use.

Feathering Strips: Tapered wood filler strips placed along the butts of old wood shingles to create a level surface when reroofing over existing wood shingle roofs. Also called horsefeathers.

Felt: Fibrous material saturated with asphalt and used as an underlayment or sheathing paper.

Fiberglass Mat: An asphalt roofing base material manufactured from glass fibers.

Flashing: Pieces of metal or roll roofing used to prevent seepage of water into a building around any intersection or projection in a roof such as vent pipes, chimneys, adjoining walls, dormers and valleys. Galvanized metal flashing should be minimum 26-gauge.

Flashing cement: See Asphalt Plastic Roofing Cement.

FM: Factory Mutual Research Corporation.

Free-Tab Shingles: Shingles that do not contain factory-applied strips or spots of self-sealing adhesive.

Gable: The upper portion of a sidewall that comes to a triangular point at the ridge of a sloping roof. (See Figure B.)

Gable Roof: A type of roof containing sloping planes of the same pitch on each side of the ridge. Contains a gable at each end.

Gambrel Roof: A type of roof containing two sloping planes of different pitch on each side of the ridge. The lower plane has a steeper slope than the upper. Contains a gable at each end.

Granules: Ceramic-coated colored crushed rock that is applied to the exposed surface of asphalt roofing products.

Gutter: The trough that channels water from the eaves to the downspouts.

Head Lap: Shortest distance from the butt edge of an overlapping shingle to the upper edge of a shingle in the second course below. The triple coverage portion of the top lap of strip shingles. (See Figure A.)

Hexagonal Shingles: Shingles that have the appearance of a hexagon after installation.

Hip: The inclined external angle formed by the intersection of two sloping roof planes. Runs from the ridge to the eaves. See Figure B.

Hip Roof: A type of roof containing sloping planes of the same pitch on each of four sides. Contains no gables.

Hip Shingles: Shingles used to cover the inclined external angle formed by the intersection of two sloping roof planes.

Horsefeathers: See Feathering Strips.

Ice Dam: Condition formed at the lower roof edge by the thawing and re-freezing of melted snow on the overhang. Can force water up and under shingles, causing leaks.

Interlocking Shingles: Individual shingles that mechanically fasten to each other to provide wind resistance.

Laminated Shingles: Strip shingles containing more than one layer of tabs to create extra thickness. Also called three-dimensional shingles or architectural shingles.

Lap: To cover the surface of one shingle or roll with another.

Lap Cement: An asphalt-based cement (conforming to ASTM D 3019) used to adhere overlapping plies of roll roofing.

Low Slope Application: Method of installing asphalt shingles on roof slopes 2"- 4" per foot.

Mansard Roof: A type of roof containing two sloping planes of different pitch on each of four sides. The lower plane has a much steeper pitch than the upper, often approaching vertical. Contains no gables.

Masonry Primer: An asphalt-based primer used to prepare masonry surfaces for bonding with other asphalt products.

Mastic: See Asphalt Plastic Roofing Cement.

Mineral Stabilizers: Finely ground limestone, slate, traprock or other inert materials added to asphalt coatings for durability and increased resistance to fire and weathering.

Mineral-Surfaced Roofing: Asphalt shingles and roll roofing that are covered with granules.

Nesting: A method of reroofing with new asphalt shingles over old shingles in which the top edge of the new shingle is butted against the bottom edge of the existing shingle tab.

No-Cutout Shingles: Shingles consisting of a single, solid tab with no cutouts.

Non-Veneer Panel: Any wood based panel that does not contain veneer and carries an APA span rating, such as wafer board or oriented strand board.

Normal Slope Application: Method of installing asphalt shingles on roof slopes 4" - 21" per foot.

Open Valley: Method of valley construction in which shingles on both sides of the valley are trimmed along a chalk line snapped on each side of the valley. Shingles do not extend across the valley. Valley flashing is exposed.

Organic Felt: An asphalt roofing base material manufactured from cellulose fibers.

Overhang: That portion of the roof structure that extends beyond the exterior walls of a building.

Pallets: Wooden platforms used for storing and shipping bundles of shingles.

Pitch: The degree of roof incline expressed as the ratio of the rise, in feet, to the span, in feet.

Ply: A layer of roofing (i.e., one-ply, two-ply).

Quick-Setting Cement: An asphalt-based cement used to adhere tabs of strip shingles to the course below. Also used to adhere roll roofing laps applied by the concealed nail method.

Racking: Roofing application method in which shingle courses are applied vertically up the roof rather than across and up. Not a recommended procedure.

Rafter: The supporting framing member immediately beneath the deck, sloping from the ridge to the wall plate.

Rake: The inclined edge of a sloped roof over a wall. (See Figure B.)

Random-Tab Shingles: Shingles on which tabs vary in size and exposure.

Release Tape: A plastic or paper strip that is applied to the back of self-sealing shingles. This strip prevents the shingles from sticking together in the bundles, and need not be removed for application.

Ridge: The uppermost, horizontal external angle formed by the intersection of two sloping roof planes. (See Figure B.)

Ridge Shingles: Shingles used to cover the horizontal external angle formed by the intersection of two sloping roof planes.

Rise: The vertical distance from the eaves line to the ridge.

Roll Roofing: Asphalt roofing products manufactured in roll form.

Roofing Tape: An asphalt-saturated tape used with asphalt cements for flashing and patching asphalt roofing.

Run: The horizontal distance from the eaves to a point directly under the ridge. One half the span.

Saturant: Asphalt used to impregnate an organic felt base material.

Saturated Felt: An asphalt-impregnated felt used as an underlayment between the deck and the roofing material.

Self-Adhered Eave and Flashing Membrane: A self-adhering waterproofing shingle underlayment designed to protect against water infiltration due to ice dams or wind driven rain.

Self-Sealing Shingles: Shingles containing factory-applied strips or spots of self-sealing adhesive.

Self-Sealing Strip or Spot: Factory-applied adhesive that bonds shingle courses together when exposed to the heat of the sun after application.

Selvage: That portion of roll roofing overlapped by the succeeding course to obtain single or double coverage at the lap.

Shading: Slight differences in shingle color that may occur as a result of normal manufacturing operations.

Sheathing: Exterior grade boards used as a roof deck material.

Shed Roof: A roof containing only one sloping plane. Has no hips, ridges, valleys or gables.

Single Coverage: Asphalt roofing that provides one layer of roofing material over the deck.

Slope: The degree of roof incline expressed as the ratio of the rise, in inches, to the run, in feet.

Smooth-Surfaced Roofing: Roll roofing that is covered with ground talc or mica instead of granules (coated).

Soffit: The finished underside of the eaves.

Soil Stack: A vent pipe that penetrates the roof.

Span: The horizontal distance from eaves to eaves.

Square: A unit of roof measure covering 100 $ft.^2$.

Square-Tab Shingles: Shingles on which tabs are all the same size and exposure.

Starter Strip: Asphalt roofing applied at the eaves that provides protection by filling in the spaces under the cutouts and joints of the first course of shingles.

Steep Slope Application: Method of installing asphalt shingles on roof slopes greater than 21" per foot.

Step Flashing: Flashing application method used where a vertical surface meets a sloping roof plane.

Strip Shingles: Asphalt shingles that are approximately three times as long as they are wide.

Tab: The exposed portion of strip shingles defined by cutouts. (See Figure A.)

Talc: See Back Surfacing.

Telegraphing: A shingle distortion that may arise when a new roof is applied over an uneven surface.

Three-Dimensional Shingles: See laminated shingles.

Top Lap: That portion of the roofing covered by the succeeding course after installation. (See Figure A.)

UL: Underwriters Laboratories, Inc.

UL Label: Label displayed on packaging to indicate the level of fire and/ or wind resistance of asphalt roofing.

Underlayment: Asphalt saturated felt used beneath roofing to provide additional protection for the deck.

Valley: The internal angle formed by the intersection of two sloping roof planes. (See Figure B.)

Vapor Retarder: Any material used to prevent the passage of water vapor.

Vent: Any outlet for air that protrudes through the roof deck such as a pipe or stack. Any device installed on the roof, gable or soffit for the purpose of ventilating the underside of the roof deck.

Vent Sleeve: See Collar.

Woven Valley: Method of valley construction in which shingles from both sides of the valley extend across the valley and are woven together by overlapping alternate courses as they are applied. The valley flashing is not exposed.

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