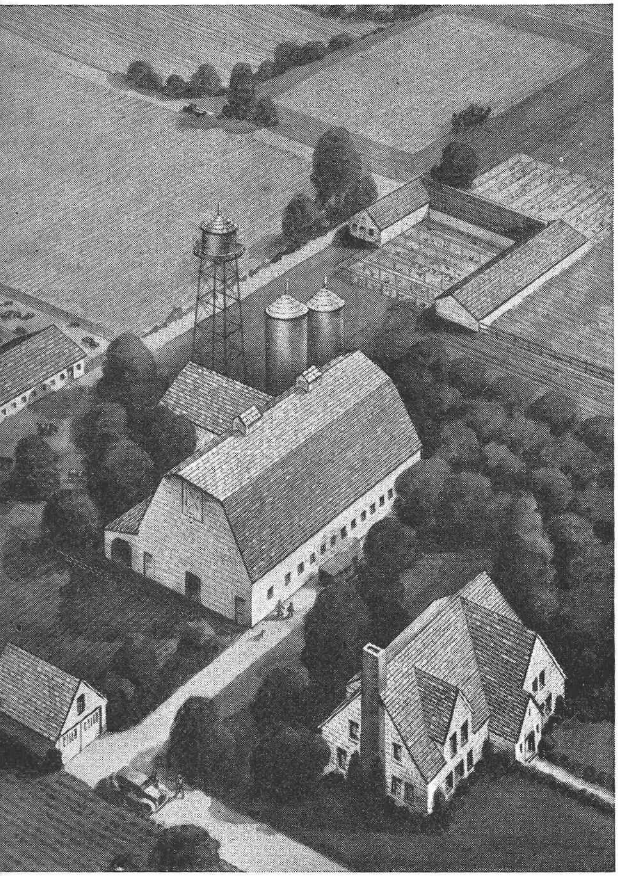
Roofs and Exterior Walls of



RED CEDAR SHINGLES

Oregon State System of Higher Education
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TABLE OF CONTENTS

	Page
Introduction	3
Farm Building Essentials	4
Roof Pitches and Types	10
Sheathing and Insulation	13
Flashing, Gutters, and Down Spouts	15
Nails	18
Red Cedar Shingle Grades	20
Application of Red Cedar Shingles	22
Overroofing with Red Cedar Shingles	27
Overwalling with Red Cedar Shingles	29
Ventilation	31
Staining and Painting	33
Snow and Wind Resistance	35
Moss on Roofs	35
Estimating	36

OREGON STATE COLLEGE FARM BUILDING PLAN SERVICE

Blue prints for most of the farm buildings illustrated or mentioned in this bulletin and many others may be ordered from the college at nominal cost. Consult your county agricultural agent for a list of available plans.

Roofs and Exterior Walls of
RED CEDAR SHINGLES

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INTRODUCTION

THE successful farmer today is a good manager and knows much about building construction as well as crops, livestock, machinery, and markets. He has good equipment and livestock and cares for them properly. The degree of his success depends somewhat on the efficiency, cost, upkeep, and durability of his farm buildings. When building new or remodeling old farm buildings, good plans, good materials, and good workmanship are essential.

The most important function of farm buildings is to provide shelter for the farmer's family, livestock, crops, and equipment. This protection comes mainly from the roof and exterior walls. If a farm building is too hot in summer or too cold in winter, the causes are probably lack of insulation in the roof or exterior walls, or excessive air leakage around doors and windows. Roofs and exterior walls give protection from the elements, sun, wind, snow, rain, and extreme temperatures. The appearance of a building or group of buildings also is quite largely determined by the roofs and exterior walls.

Since it is recognized that many farm buildings need only new roofs and exterior walls to make them modern and well insulated, emphasis in this bulletin is placed on modernization and repair with red cedar shingles. By observing the suggestions offered, farmers should be able to shingle roofs and exterior walls of new buildings or reroof and cover the exterior of old buildings with a minimum outlay of cash.

When new construction or modernization of farm buildings is contemplated, consideration should be given to the many advantages of using red cedar shingles for the roof and exterior walls. More than 90 per cent of all wood shingles manufactured in the United States are made from Western Red Cedar, which is fine, even-grained, and of uniform texture—ideal for high-grade, long-life shingles.

FARM BUILDING ESSENTIALS

The farm house. An attractive and comfortable home contributes greatly to the contentment of the farm family. Many old farm houses that are sturdy and sound can be brought up to modern standards of comfort, convenience, and appearance for less than the cost of a new building. This has been done in many cases with a small outlay of cash when the farmer has contributed considerable labor toward the improvements.

Much heat is often lost through the roof. An example may be seen on a frosty morning when frost clings to the overhanging gables and eaves but quickly melts from that portion of the roof through which heat is escaping. Siding that has become loosened by shrinking, warping, or action of the weather should be tightened with rust-resisting nails. A good coat of paint and the liberal use of putty may seal many cracks after the siding is tightened, but a much more effective and practical method of insulating houses is to shingle the outside of the walls, using a building paper or felt between the shingles and the siding.

The garage. Red cedar shingles may be used on the exterior walls and roofs of garages. For a single car garage, an outside width of 12 feet has been found satisfactory, while for a two-machine garage, about 20 feet of width is necessary. Lengths of less than

Figure 1. Home comfort depends on the proper construction of roofs and exterior walls.

20 feet are seldom desirable. Trucks often require greater lengths, while farm tractors can be accommodated in about 16 feet. Wall materials for a double garage will cost only from 20 to 25 per cent more than for a single garage. Use of the *car port,* which is a garage without doors, appears to be increasing. Sometimes only a roof is provided or a roof and two sides, where open sides are sheltered.

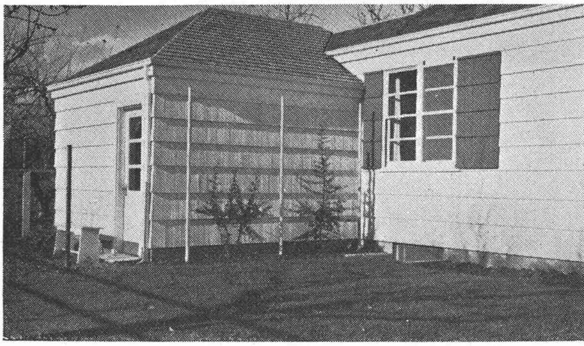


Figure 2. Garage roof slopes and material should conform to the house. Side wall exposure same as house.

Community halls. Farm organizations are erecting community buildings that closely relate to the economic and social life of the farm people. Such community buildings should be so arranged and constructed as to promote constant community activity leading to better living on the farm and a better rural civilization. Comfortable buildings, easily and quickly heated, are essential. Tight sheathing and building paper in both roof and side walls are recommended.

Figure 3. A rural community hall for social and recreational purposes.

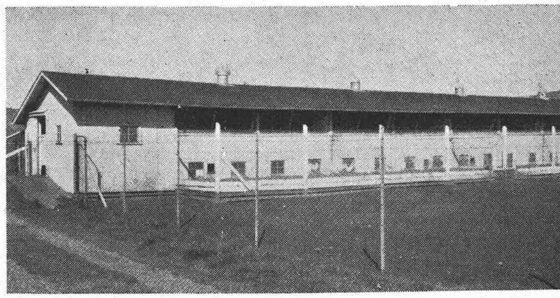


Figure 4. Fowls require protection from extremes in temperature.

Wood shingles are usually less expensive than other forms of siding when laid over such a base.

Since it is not necessary, except for appearance, to paint or stain shingles, the cost of painting the side walls may sometimes be saved when shingles are used.

Poultry housing. It is important to provide poultry with protection from extremes of either cold or heat. Excessively low temperatures should be avoided whenever possible. Adequate insulation for comfort in winter and summer increases production. Laying houses, brooder houses, and egg storage houses should all be fully insulated. When the roof slopes sufficiently, red cedar shingles are the most practical and economical roof covering for poultry buildings.

Dairy buildings. Comfortable housing is particularly desirable for dairy cattle. Insulation aids in providing temperature control, which is desirable for efficient operation of natural-draft ventilation systems. A properly constructed milk house is essential in the production of milk and cream of high quality.

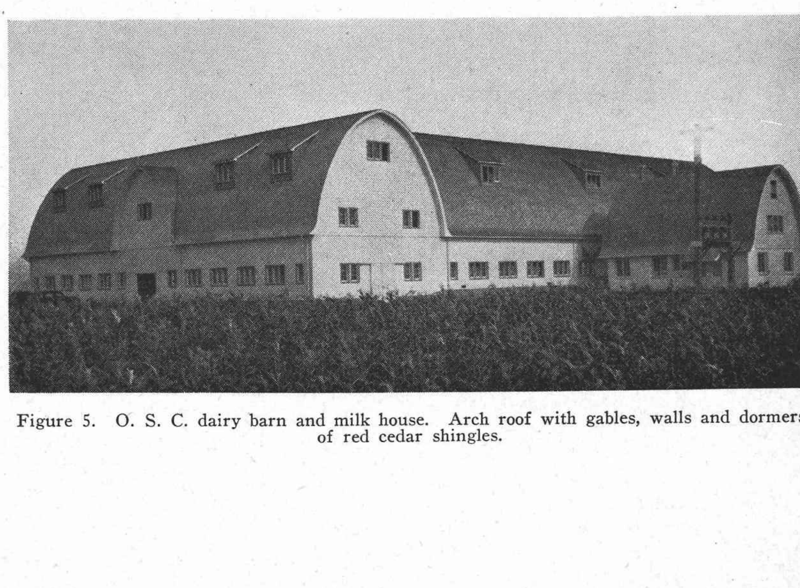


Figure 5. O. S. C. dairy barn and milk house. Arch roof with gables, walls and dormers of red cedar shingles.

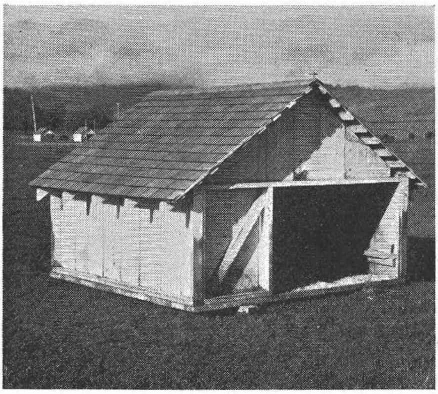


Figure 6. Portable hog house.

Manure tanks. Proper handling of barnyard manure is one of the best methods of maintaining soil fertility. When manure is piled in the yard, rains wash away soluble fertilizing elements and exposure causes fermentation and loss of valuable nitrogen. The value of nitrogen, phosphorus, potash and sulphur saved by proper farm storage will pay for a manure pit and shelter within a few years. Manure tanks may be built of wood or concrete and covered with a roof of red cedar shingles laid over open sheathing. Wooden liquid manure-storage tanks are inexpensive and have been in continuous use on Oregon farms for more than 15 years. Carefully designed plans for manure tanks are obtainable through your county agricultural agent.

Hog houses. To grow hogs profitably, it is essential to provide warm, dry, clean, well lighted, and comfortable quarters in which the pigs may find protection and grow to marketable animals with a minimum of feed and care. Absence of hair, the protective covering common to other farm animals, makes warm shelter necessary for pigs. Often a chilled pig is a killed pig. Many of the pigs farrowed are lost before weaning age, many of them from chilling. Properly insulated farrowing houses decrease these losses.

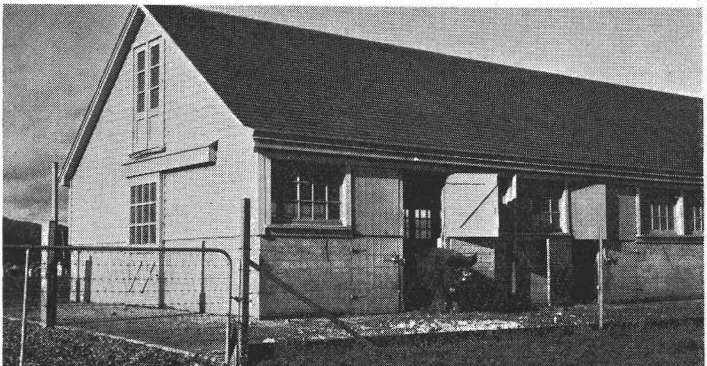


Figure 7. Community or central hog house.

A good house is one that makes it possible to save pigs during unfavorable weather common to early spring farrowing time. In general, a good house is properly ventilated, warm and admits the maximum of sunshine. Wide ranges of temperature, as well as drafts, should be avoided. Tight sheathing and building paper under red cedar shingles are the least expensive beginnings of proper insulation. Buildings for hogs must provide free circulation of air in hot weather.

Sheep housing. Elaborate and expensive structures are not advocated for sheep. Such buildings do not insure economy in management and are not essential to the welfare of the flock. Protection from storms is necessary, especially at lambing time, and shade should be provided in summer. Walls and roofs of red cedar shingles over open sheathing will provide adequate protection.

Storage buildings. Potato and vegetable storage houses make possible a longer marketing period for the crop and insure minimum loss from moisture and decay. A dug-out storage cellar covered with straw and soil is admirably adapted to potato storage wherever good drainage can be obtained. In regions of heavy rainfall, the storage cellar should be provided with a watertight roof. Red cedar shingles over open sheathing provide necessary protection from excessive rainfall. An air passage between the superimposed roof, and the straw-dirt covering preserves the rafters from decay.

Granaries must have watertight walls and roofs, which are best constructed of red cedar shingles. Farmers who are not aware

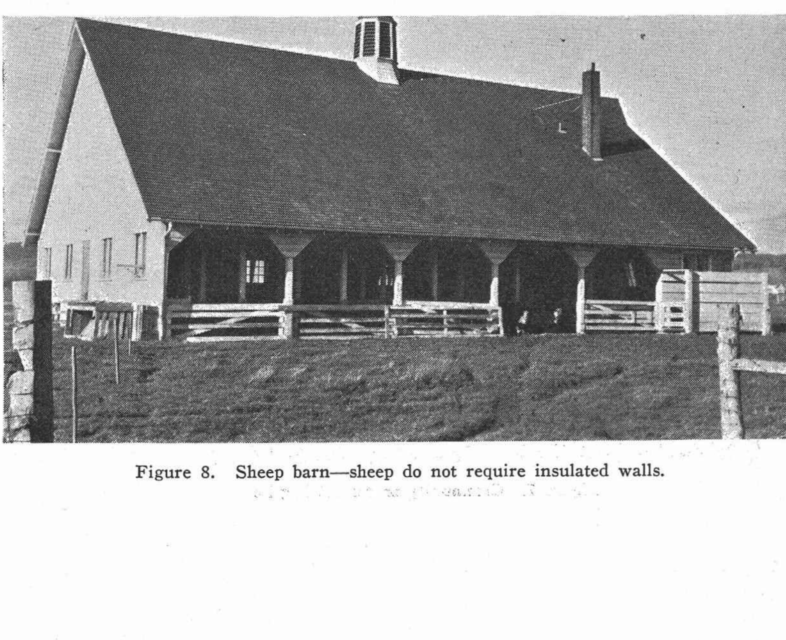


Figure 8. Sheep barn—sheep do not require insulated walls.

that foundations of grain buildings must support a greater weight than do those of most farm buildings frequently construct grain bins, elevators, and corn cribs with inadequate foundations which later may cause leaks in roofs and walls due to unequal settling.

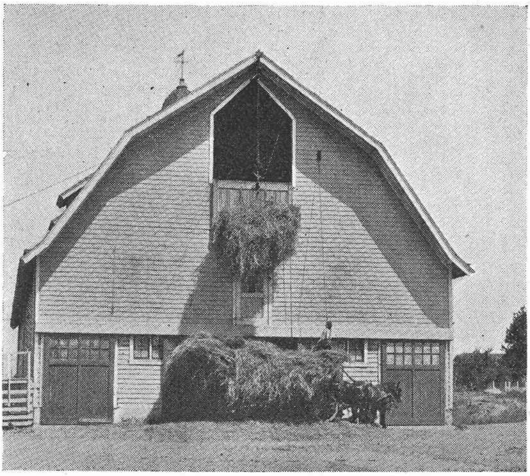


Figure 9. Shingles on exposed gables give best protection from the elements.

Moisture condensation within the bin, which often causes grain to spoil, will not occur if the grain is thoroughly dry or if the temperature of the inside surface of the walls and roof is kept above the dew points of the air within the bin. Tight sheathing and paper under shingles in both walls and roof will prevent rapid changes in temperature.

Even though hay has been well cured before storage, it will heat if it becomes wet. Heating, caused by rain coming through a leaky roof, may continue until the ignition temperature is reached and the

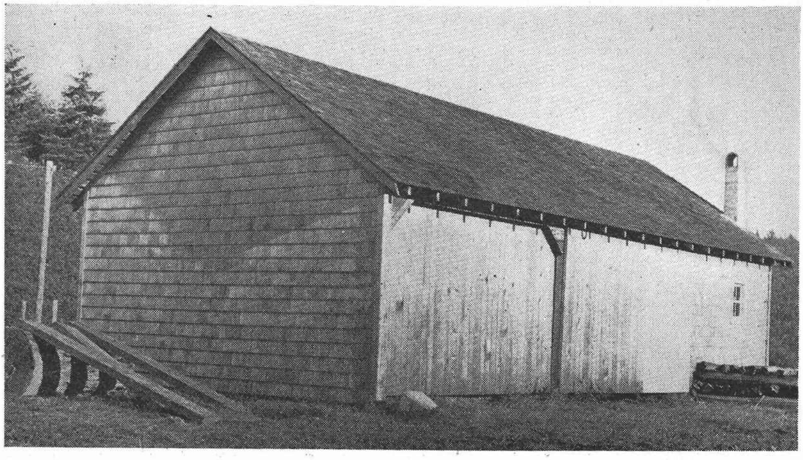


Figure 10. The life of farm machinery is prolonged through proper care.

hay bursts into flames by spontaneous combustion, destroying building and contents. Flax straw is particularly dangerous under such conditions.

Implement sheds and farm shop. Rust and rot annually cause millions of dollars loss on farms in the United States. Expensive machinery depreciates rapidly in value and usefulness when stored in "the great out-of-doors." A far greater loss than that from rapid deterioration is the resulting inefficiency of machines that often break down at critical times. Implement sheds 16 to 20 feet in width will accommodate one row of machines, while those 22 to 26 feet wide will shelter two rows. Sheds for storage of implements need no insulation, but there should be at least one building on each farm constructed with tight roof and side walls where machine repairs can be made with comfort in the winter time.

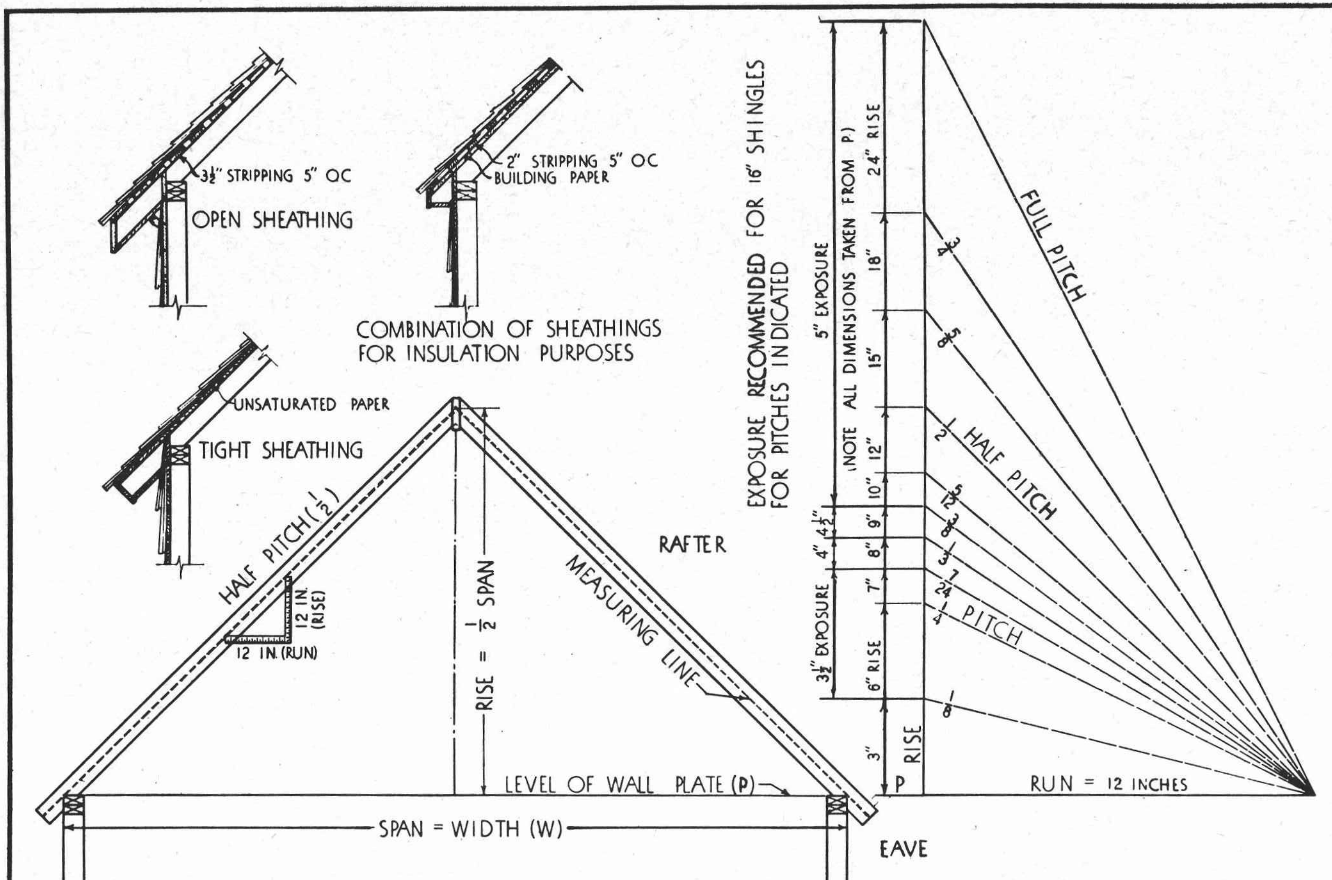
ROOF PITCHES AND TYPES

The roof is a very important feature of all kinds of buildings since it is depended upon to protect the interior and to some extent the exterior from the weather.

Pitch is the amount of slope in a roof. Before explaining the rules for figuring roof pitch it is necessary to define the terms and show how to make certain measurements. The *span* is the total distance between the outer edges of the plates on the side walls. *Run* and *rise* are easily understood when considered as two sides of a right angle triangle. *Run* corresponds to the horizontal base of the triangle, and *rise,* the vertical side; the sloping side (hypotenuse) of the triangle corresponding to the roof slope. The longest *run* in a gable roof is half the span. (See Figure 11.)

The *pitch* of a gable is determined by dividing the *rise* by the *span,* or *by dividing the rise by twice the run.* The pitch of other types of roofs having straight slopes, such as shed or gambrel roofs should be determined by the latter rule only, dividing the rise by twice the run. Another way of stating this rule is: Divide the rise, per 12 inches of run, by 24. A full pitch gable roof is one with the rise equal to the span. A half pitch gable roof is one with the rise equal to half the span. (See Table 1, Columns 1 and 2, Page 36).

Example:—Figure the pitch of a gable roof having a rise of 6 inches to a run of 12 inches. Use the rule of dividing the rise by twice the run. Then 6" (the rise) divided by 24" (twice the run) equals 6/24 or 1/4 pitch. The height of the ridge will be 1/4 of the width (or span) of the building.



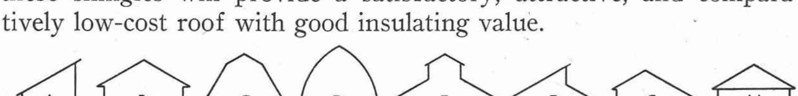
ROOF PITCHES

If it is desired to build a *third pitch gable* roof with a 12 foot span, the height of the ridge board would be one third of 12, or 4 feet. In a third pitch *shed* roof on a building 12 feet wide, the height of the ridge above the lower plate would be one third of 24 feet, or 8 feet, because a shed roof must be considered as one side of a gable roof in figuring pitch.

Roofs found on most farm buildings may be grouped into eight general classes; namely, shed, gable, combination, hip, gambrel, arch or gothic, monitor and half monitor. The *shed,* or "lean-to," roof has a single slope (Figures 12A and 44). The *gable* roof has two equal slopes that meet at the center of the building to form a ridge, with a gable at the end (Figures 12B and 45). A *combination* (gable) roof, commonly used on poultry houses and implement sheds, has two unequal slopes (Figures 12G and 50). The upper ends of the rafters meet at a point other than the center of the building. This type of roof affords greater head clearance in the front part of the building. The *hip* roof slopes upward from all four walls to the center, meeting in a point or a short ridge (Figures 12H and 46). It sometimes has a deck at the top instead of a ridge. The *gambrel* roof is a gable roof with a horizontal hip and two slopes on each side (Figures 12C and 47), while a *gothic* roof is curved (Figures 12D and 49). The *monitor* is a combination of a gable roof and two shed roofs (Figures 12E and 48). The *half monitor* consists of two shed roofs with one ridge directly above the other, and a wall between the two ridges (Figure 12F).

The gothic, or arched roof, is increasing in popularity for farm barns as it has no obstructions in the loft. Great strength is obtained by the arch construction if properly constructed. Monitor roofs are used to some extent on stables and dairy and beef-cattle barns. Windows may be installed in the walls of the raised central portion. The half-monitor roof is used frequently on poultry and hog houses where windows may be installed in the upper wall to permit better lighting in the pens on the north side of the building, as this type of structure is usually built facing the south.

Red cedar shingles may be used on all these types of farm-building roofs. If properly laid, on slopes of quarter pitch or better, these shingles will provide a satisfactory, attractive, and comparatively low-cost roof with good insulating value.



Shed Gable Gambrel Gothic Monitor Half Monitor Combination Hip

Figure 12. Roof types.

SHEATHING AND INSULATION

Economy and comfort demand that the roof and exterior walls of the farm home be well insulated against cold in winter and heat during the summer. If the roof or exterior walls are not insulated against the transmission of heat in an effective manner, the heat lost through the roof and walls must be continually replaced during the cold winter months. On cool days, uniform, comfortable temperatures are more easily maintained if the walls and roof are insulated. During the summer, insulation in the roof and exterior walls helps to keep the farm home comparatively cool and comfortable.

Many farm buildings, including the poultry house, farrowing house, lambing quarters, and buildings in which damage would result from freezing of water or crops should have moderately well insulated roofs and exterior walls. Laying hens will produce more eggs in winter if they are housed in comfortable quarters. Young pigs and lambs will usually thrive better if protected from cold. One severe freeze during the winter will cause much inconvenience and high repair bills if buildings are so constructed that the water pipes freeze. There is a large annual loss of vegetable crops such as potatoes, due to freezing in storage. This loss would be reduced if some insulation were provided.

Sheathing. It is a common practice to use open sheathing on dwelling roofs. It is recommended that this practice be discontinued unless some form of commercial insulation is used. Tight sheathing, consisting of shiplap or matched boards, and paper should be used on both the roof and outside walls of the home. Where no insulation is required on the roof or side walls open or slat sheathing is recommended.

A greater amount of roof insulation may be obtained by a combination of sheathings (See Figure 11), applying first, tight sheathing, then paper, and then the customary stripping to which the shingles are nailed. The strips are applied over the paper, spaced the same distance, center to center, as the exposure of the shingles. Experience with Experiment Station buildings has indicated that the extra insulation obtained by the use of tight sheathing and paper under the customary open-strip sheathing will pay for itself in fuel conserved, in addition to the increased comfort to the occupants in both winter and summer.

Tight sheathing reduces loss of heat through the roof. Shingles laid on tight sheathing are twice as effective as shingles laid on 1" x 4" boards spaced 5" center to center. Shingles, laid on 1" x 4" strips over tight sheathing, are approximately *four times* as effective as shingles laid on 1" x 4" strips spaced 5" center to center. (See Figure 11.)

Tight sheathing has other advantages over open sheathing where an insulated building is desired. One of these is that tight sheathing affords continuous nailing surface, while in open sheathing care must be taken to insure that nails do not miss the sheathing boards. The lower grades of lumber are satisfactory for tight sheathing when covered with building paper.

Plywood is an excellent base for shingles on side walls and roofs of farm buildings. When roof shingles are applied over plywood, on 1" x 2" or wider nailing strips, spaced same distance c. to c. as shingle exposure, valuable heat, dust, and wind insulation is provided by the tight sheathing and air spaces. On side walls, shingles may be applied directly over 5/16-inch plywood.

Where heat insulation is of minor importance, open sheathing consisting of 1 x 4's spaced the same distance center to center as the exposure of the shingles, or 1 x 6 boards spaced twice the distance on centers as the exposure of shingles, is good practice. (See Figure 11.) The strips should be properly located with respect to the starter row in order to receive the nails properly.

In side walls when tight sheathing is omitted, building paper, if used, should be placed in vertical strips with edges of paper placed over the studs and held in place by cleats, or nails with tin washers, before the application of the nailing strips. In applying building paper on roofs and walls of buildings, all edges of each sheet of paper should be securely fastened to studs, plates and sills in outside walls, and to rafters, ridge boards and draft stops placed between rafters above plates.

The purpose of using building paper in roof and wall construction is to prevent the passage of air and dust through the roof and walls, and around the window and door frames. Rosin-sized building paper, "dry" or unsaturated felt, or asbestos paper can be used. Building paper alone, due to its thinness, is not to any extent an insulating material.

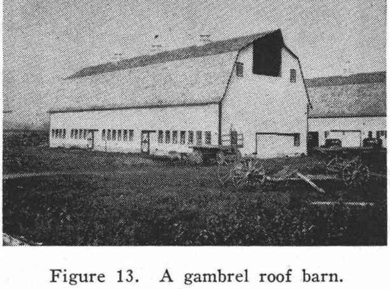


Figure 13. A gambrel roof barn.

Tight sheathing and paper greatly reduce air infiltration. Tests made with a shingled wall, with shingles five inches to the weather, laid on 1" x 4" boards spaced five inches center to center, showed more than 300 times as much air infiltration as through shingles with 7½-inch exposure laid on tight sheathing (ship lap) and building paper, at a wind velocity of 15 miles per hour in both cases.

Shingle exposure. When shingles are laid with the standard exposure of 5 inches to the weather, 4 bundles will cover 100 square feet of area. In all roof construction, there should be 3 layers of wood at every point, to insure complete freedom from leakage in heavy wind-driven rainstorms. This means that there should never be more than one-third of the shingle exposed to the weather. Exposure of the shingle to the weather depends on two things: length of shingle and pitch of roof. The steeper the pitch, the longer the life of the roof; and the less exposure necessary. On roofs of a third pitch or less, it is recommended that the exposure be reduced. See Table 1, Column 4 (Page 36).

FLASHING, GUTTERS AND DOWNSPOUTS

Flashing. Too great emphasis cannot be placed on the vital importance of flashing ridges, valleys, and the junction of the roof and the outside walls with the chimney or other vertical surfaces. Most of the leaks that occur in otherwise good roofs and outside walls originate at these points.

There are a number of flashing materials. All exhibit varying degrees of durability under different conditions of exposure. It is important that the lasting quality of the flashing material selected should be equal to that of the new roof or side walls. Galvanized iron is an excellent material for this purpose. It consists of mild steel sheets that have been coated with a layer of zinc either by an electroplating process or by dipping the sheets in a bath of molten zinc. Reasonably heavy metal should be used—preferably 24 or 26 gauge—and this should have at least a 1½-ounce coating per square foot.

Copper is a superior material for flashing. It is easier to handle than G.I. (galvanized sheet metal), although G.I. is used more often because of its lower cost. Tin is often used and is satisfactory if the surface is not damaged. It is usually no cheaper than G.I.

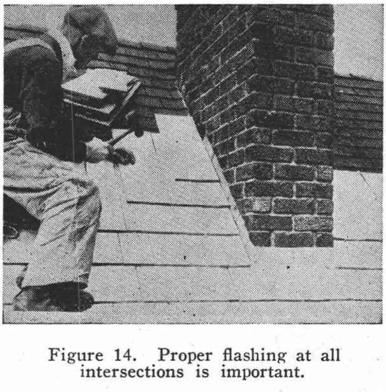


Figure 14. Proper flashing at all intersections is important.

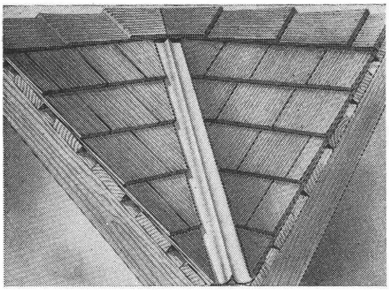


Figure 15. Water stop in valley to prevent water from one slope splashing under shingles of opposite slope.

On roofs of one-half pitch, or steeper, the valley sheets should extend up on each side of the center line of the valley for a distance of *at least* 7 inches. On roofs of lesser pitch, wider valley sheets should be used, extending at least 10 inches on either side. Care should be used in placing valleys in situations where snow is apt to drift in large quantities, so that if ice dams form, water will not back up to such a high point in the valleys that it will flow over the edges of the flashing under the shingles. If the slope of a roof on one side of a valley is one-half pitch, and on the other side is one-fourth pitch, the valley sheet should extend upward on the steep side for a distance of at least 7 inches and on the other side at least 10 inches. Such variations in pitch, however, are not recommended.

The open portion of a valley should be at least 4 inches wide, in normal cases, but valleys may taper from a width of 2 inches where they start to a wider width as they descend, at the rate of $\frac{1}{2}$ inch per 8 feet of length. As an alternative, a vertical ridge, or water stop, can be made by crimping the metal up in the center of the valley (Figure 15). The purpose of this is to prevent the splashing over of water flowing from a steep slope upon and under the shingles of a lower slope or pitch. Butting of the shingles together in the valleys at the center of the line to form so-called "closed valleys" is not recommended.

Chimney flashings should be run up under the shingles for at least 6 or 8 inches (Figure 16) (B) and should be counterflashed (A), particularly on the upper side, if the chimney is located on a slope. The use of a "cricket" (C) for flashing above chimneys on side-roof slopes is good practice. This flashing prevents the accumulation of water or snow on the high side of the chimney. A galvanized iron ridge is shown at (D).

Where the chimney passes through the roof, the construction should provide space for expansion due to temperature changes, settling, or slight movement of the chimney during heavy winds. Vertical surfaces must be flashed with cap flashing (A) inserted into joints between brick and bent down over the base flashing. The cap flashing should not be fastened to the base flashings. Plumbing vent stacks should be flashed so as to permit the pipe to settle without causing leaks. Lead flashing is sometimes used in plumbing vents.

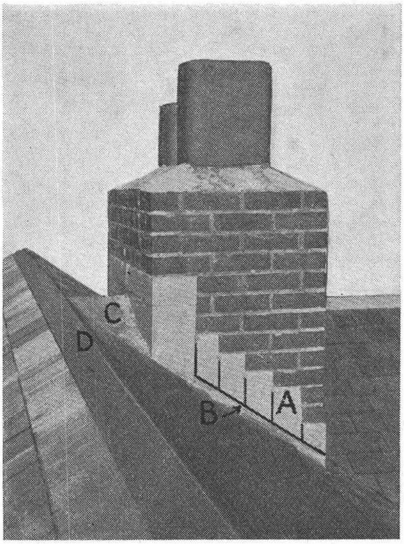


Figure 16. Metal flashing, ridge, cricket, and counter flashing.

When reroofing over shingles or composition roofing, all loose flashing should be securely fastened in place and joints filled with roofer's cement, or if the joint in which the flashing is anchored is wide, oakum rolled in roofer's cement and calked in the joint will prove economical and effective. The metal of open valleys, if badly corroded, should be replaced with new metal. Loose mortar of chimneys should be raked out and the joints repointed with a mixture of one part Portland cement, one part lime, and six parts sand.

In shingling a roof section that terminates at one edge in a valley, the shingles for the valley should be carefully cut to the proper angle at the butts and should be nailed in place first.

A length of 6-inch bevel siding (Figure 17) nailed along the edge of the gable parallel with the end rafter, with the thinner side away from the edge, can be used to give the shingles a slight tilt away from the edge of the gable. The butts of the end shingles that rest on this strip of siding may be cut on a slight slant, so that drainage will be away from the gable edge along the slanted butts. This will prevent drip from the gable and the formation of icicles during cold weather.

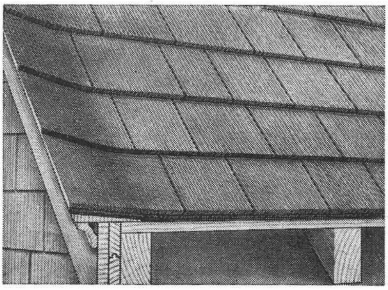


Figure 17. Drip from gables can be prevented by giving the edge shingles a slight tilt by using a bevel strip.

Gutters and downspouts. Gutters and downspouts are necessary to prevent the formation of water holes around the building. Gutters may be of wood or metal.

In regions of heavy snowfall, the outer edge of the gutter should be one-half inch below the extended slope of the roof, to prevent snow from banking on the edge of the roof and causing water to dam up under the shingles. The hanging gutter is well adapted to such construction. Box gutters should be set out from the frieze board on strips to provide ventilation behind the gutter. Bottoms of gutters should slope about one-sixteenth inch per foot toward the outlet.

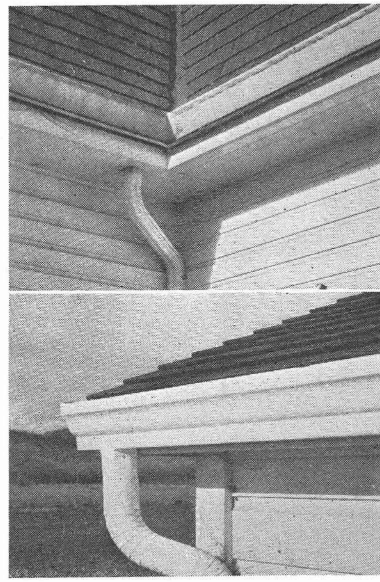


Figure 18. Gutters and downspouts. (*Upper*) "Webfoot." (*Lower*) Box, or "O.G."

The downspouts should be large enough to carry the water from the gutters and may be of plain or corrugated metal. In cold climates there is an advantage in using the corrugated instead of plain metal for downspouts. The latter may burst because of expansion. Wire baskets or guards should be used at gutter outlets to prevent leaves and trash collecting in the downspouts.

NAILS

Experience has proved the wisdom and economy of using the right kind of nails when applying red cedar shingles on roofs and outside walls of new and old buildings. For an additional outlay that is hardly noticeable in the total cost of the improvement, the right nail will double the life of the roof. Bright or blued steel-wire nails soon rust out, leaving the shingle without a nail to hold it.

Use only hot-dipped, zinc-coated nails or other rust-proof nails in applying red cedar shingles. Zinc-coated nails have the strength of steel and will not corrode or rust. Copper nails resist corrosion, but are hard to drive into the sheathing without bending, and are more costly. Cement-coated nails are likely to rust.

The hot-*dipped,* zinc-coated nail has a rather rough surface and a heavy coating of zinc. The large head, slim shank and rough surface that characterize this nail are very important. Hot-dipped, zinc-coated nails of the proper size and shape are made by leading manufacturers and are available everywhere.

Nails should be long enough to penetrate about three-fourths the thickness of the sheathing.

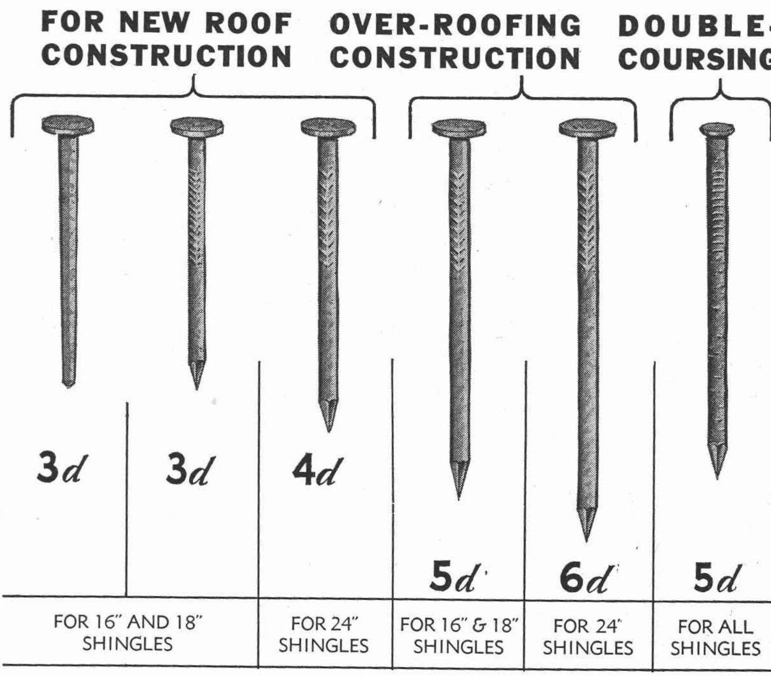


Figure 19. Use zinc-coated nails.

For new construction, use three-penny nails ($1\frac{1}{4}$-inch, $14\frac{1}{2}$ gauge) for 16" and 18" shingles, and four-penny nails ($1\frac{1}{2}$-inch, 14 gauge) for 24" shingles. For over-roofing, use five-penny nails ($1\frac{3}{4}$-inch, 14 gauge) for 16" and 18" shingles, and six-penny nails (2-inch, 13 gauge) for 24" shingles. In double-course wall construction, use five-penny nails ($1\frac{3}{4}$-inch, 14 gauge) for all shingles. (See Figure 19.)

For estimates of nails, see the section on estimating, page 46.

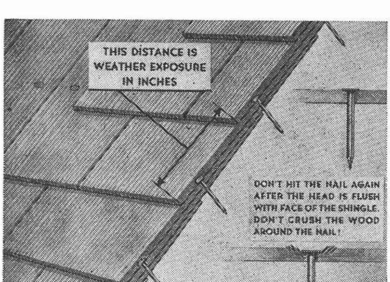


Figure 20. Nails should never be more than 2 inches above the butt line of the next course.

RED CEDAR SHINGLE GRADES

A farm housing survey made by the United States Department of Agriculture in cooperation with Oregon State College indicates that, on farms visited, fully half of the buildings needed roof replacements or repairs. This is largely due to poor grades of wood shingles that have been sold and used in the past.

The Bureau of Standards of the United States Department of Commerce, in cooperation with red cedar shingle manufacturers, has established quality standards for the manufacture of red cedar shingles (Commercial Standards 31-38). The purpose of these standards or specifications is to present a common basis of understanding between the producers, distributors and consumers of shingles. By the acceptance of these standards or specifications, it is hoped that interest may be increased in the manufacture, sale and use of shingles graded strictly in accordance with the government standards.

The United States Department of Commerce has no regulatory power in the enforcement of these standards. Its major function is to act as an unbiased coordinator to bring all branches of the industry together for the mutually satisfactory adjustment of trade standards. The consumer has no governmental protection in the enforcement of these standards. Their adoption and enforcement are left entirely with the manufacturers.

A majority of the shingles made from red cedar are produced by manufacturers who have accepted these commercial standards (C. S. 31-38) as their standard of practice in the production and distribution of red cedar shingles. These manufacturers maintain rigid inspection service. Frequent inspection, without warning, is made of their production. They label each bundle produced. These labels clearly state that the shingles have been manufactured in compliance with the U. S. Department of Commerce (Commercial Standards 31-38) and are guaranteed by the manufacturer to meet all the quality requirements of the standard as set up by the government agency. No manufacturer who is unwilling to meet these requirements can use labels of the association or associations that state that shingles so identified have been inspected and guaranteed as to grade.

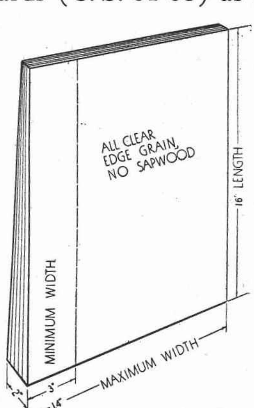


Figure 21. Thickness of five 16-inch shingles measures 2 inches.

When grades of any manufacturer fall below the recorded standard of the industry, permission to use the label of the association of manufacturers is revoked.

Unlabeled bundles of shingles or those bearing labels of individual manufacturers even when they *imply* that they have been manufactured in accordance with the U. S. Department of Commerce standards (C. S. 31-38) may be of questionable quality. These shingles even though they are labeled and guaranteed by the individual manufacturer to be of standard quality are purchased at considerable unnecessary risk.

Length of shingles. Three different standard lengths of wood shingles are recognized. These standard lengths are 16, 18 and 24 inches. Ten per cent of the shingles in any shipment may be one inch over or under the specified length. For exterior walls and roofs of farm buildings, it is customary to use shingles of 16" length.

Thickness of shingles. The thickness of shingles at the butts varies with their length, but is the same for all grades of the 16" length. Shingles 16 inches long must be so thick that five shingles when measured across the butts or thickest portion, when green, will measure two full inches. These are known as 16"-5/2 shingles. Five butts of 18-inch shingles measure 2 inches or $2\frac{1}{4}$ inches. These are known as 18"-5/2 or 18"-5/$2\frac{1}{4}$ shingles. The longest commercial shingles are 24 inches in length and the thickness at the butt is one-half inch—four such shingles will measure two full inches. These are known as 24"-4/2 shingles.

Since 16-inch shingles are packed with 20 courses on each side of the band sticks, a bundle of 16-inch shingles must, therefore, measure 8 inches in thickness when green. If measured after seasoning has occurred, an allowance of $\frac{1}{4}$ inch per bundle is made for shrinkage. In No. 3 grade only, an additional allowance of $\frac{1}{4}$ inch is made for variations in sawing.

The following grades of 16"-5/2 red cedar shingles are recognized by the U. S. Department of Commerce (Commercial Standards 31-38):

No. 1 shingles. No. 1 red cedar shingles represent the best grade that is manufactured. These shingles are intended primarily for roof construction, where the shingles should lie flat and tight and where there must be complete protection from rain water driven by high winds. (See Figure 21.)

No. 1 shingles must be 100% edge or vertical grain, 100% clear, and 100% heartwood. None of these shingles should be wider than 14" and none narrower than 3". There should be 20 courses of shingles at each end of the bundle. Not more than 10% of the combined width of the shingles laid side by side (running inches) in any shipment may be less than 4" in width.

No. 2 shingles. Shingles of No. 2 grade must be clear or free from blemishes for three-fourths of their length as measured from the butts. A maximum width of only one inch of sapwood is permissible in the first ten inches. Mixed vertical and flat grains are allowed. No shingles shall be wider than 14" and none narrower than 3". Not more than 20% of the running inches in any shipment may be less than 4 inches.

No. 3 shingles. No. 3 shingles must be 8" clear or better and may contain sapwood. No shingles shall be wider than 14" and none narrower than 2½" and not more than 30% of the running inches in any shipment may be less than 4" wide. Knot holes up to 3" in diameter are permitted in the upper half.

Selection of shingles. It will pay to use only the best grade of shingles. Only No. 1 grade red cedar shingles should be used for permanent roof construction and the best wall construction. The No. 2 grade of shingles should be used only on temporary roofs or for undercoursing, and for side walls. The No. 3 shingles should be used only on outside walls as undercoursing under No. 1 or 2.

APPLICATION OF RED CEDAR SHINGLES

Roof shingles should be spaced one-eighth to one-fourth inch apart. Wall shingles are laid without spacing. The first course of shingles at the eaves should be doubled, and for all first-class work a triple layer of shingles is recommended. The second layer in the first course should be nailed over the first in such a way that the joints in each course are not less than 1½ inches apart, the minimum "side lap" allowable, and if possible, should be "broken" by a greater margin. None of the joints in the three layers should match up (See Figure 22).

Butts should project from 1 to 1½ inches beyond the first roof board so that rain water will be

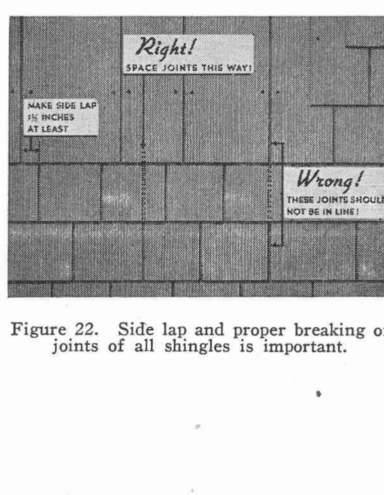


Figure 22. Side lap and proper breaking of joints of all shingles is important.

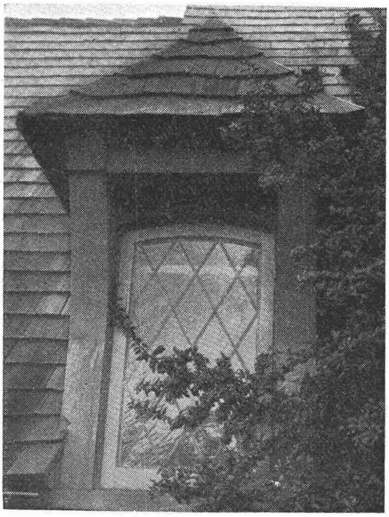


Figure 23. Neat "set in" hip shingle.

spilled into the gutter and not down the side of the building and barge board (See Figure 11).

In applying successive courses, correct exposure should be measured from the butts in the preceding course, and care should be taken to insure the proper side lap over joints between shingles (Figure 22).

It is a good plan to measure courses from the ridge at intervals, so that errors in the alignment of courses can be corrected by adjustments that will not be discernible to the unaided eye. This insures that the last or final course at the ridge will have shingles of the proper length of butt exposure. As the last course is nailed in place, that portion of the shingles projecting beyond the center line of the ridge should be sawed off.

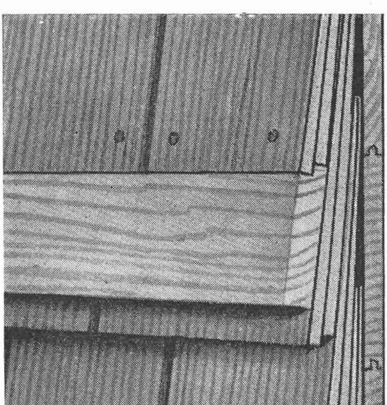


Figure 24. Rabbeted guide for double coursing exterior walls.

When flat-grained shingles are used, greater service will be obtained if they are laid with the bark side (that which was nearest the bark in the tree) exposed, as this side weathers better than the heart side. Shingles so laid are not likely to become waterlogged nor to turn up at the butt. Be careful not to place heart centers above or below cracks.

Application of shingles on exterior walls. In applying red cedar shingles to the exterior walls of new buildings, tight sheathing should be used, preferably applied diagonally, unless insulation is not desired. Five-sixteenths inch plywood sheathing is an excellent base for shingles.

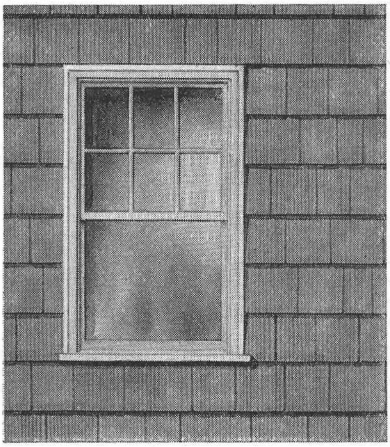


Figure 25. Choose an exposure that will bring butt lines even with tops and bottoms of wall openings.

For buildings such as implement sheds, hay barns, irrigation pump houses, beef cattle barns, manure pits or tanks, and sheep shelters, open or slatted sheathing is sufficient.

The application of a good grade of building paper on the sheathing before the shingles are applied will reduce air infiltration through the wall to a minimum.

When shingles are laid in single course, the weather exposure on exterior walls should never be greater than half the length of a shingle, less one-half inch, so that two layers of wood will be found at every point in the wall. When "double coursing" is employed, however, exposure up to three-fourths of the shingle becomes possible.

When "double coursing" a wall, the exposed shingles are usually No. 1 grade. The shingles that are covered in each course may be No. 2 or No. 3 grade. The double courses of shingles applied in this way provide a high degree of insulation against heat losses.

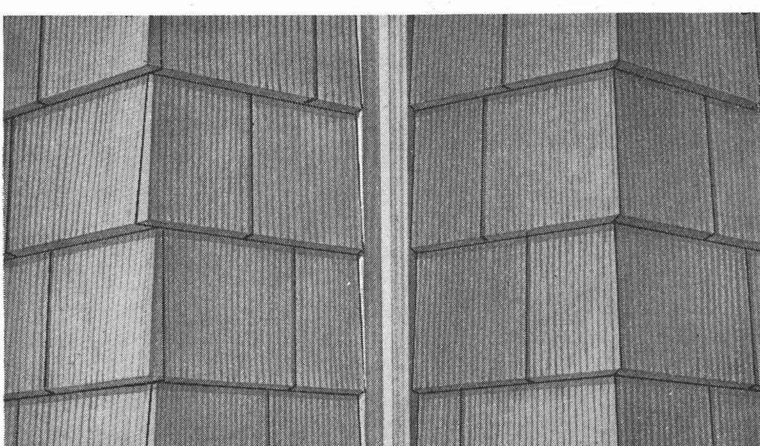


Figure 26. A "laced" corner; a butted corner; and a mitered corner. Corners should be neatly made. Inside corners can be made by nailing a 1½-inch or 2½-inch square strip in the corner and jointing the shingles in each course against this strip.

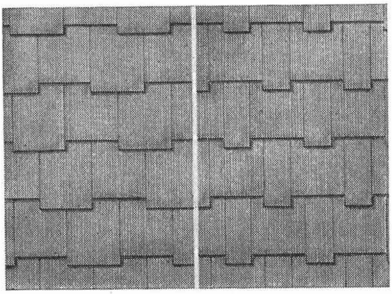


Figure 27. Monotony in large wall areas can be prevented.

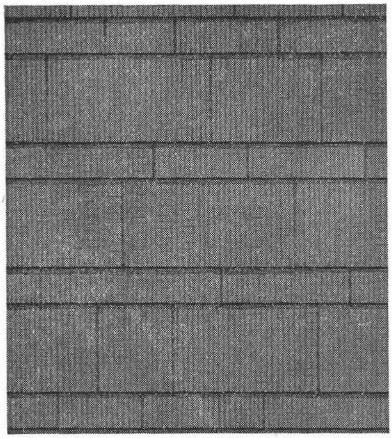


Figure 28. An unusual method of double coursing side walls.

No special tools are required to apply double-coursed walls. The method is simple and requires only a good workman to cover the walls quickly and well. (See Figure 24.)

Choosing proper exposure. In choosing the exposure to be used on a side wall, to obtain the best effect and to avoid as much cutting of the shingles as possible, the butt lines, or so-called "shadow lines," should be even with the upper lines of the window openings, and also wherever possible, with the lower lines of such openings (Figure 25). It is also better to tack a temporary strip to the wall to use as a guide for placing the butts of the shingles squarely, rather than to attempt to shingle to a chalk line, when straight shadow lines are desired. In applying side-wall shingles with tight or closed joints, the butts should be placed squarely on the strip, and if the edges of some of the shingles, despite the care that is used in manufacture, are not exactly at right angles with the butts and are not strictly parallel, the edges can be shaved off straight with a knife.

Figure 29. Shingle thatch roof provides unusual interest.

Hips and ridges. Good tight hips and ridges are necessary to avoid air infiltration and prevent leakage from rain. A good type of construction is the modified "Boston" hip or ridge. In constructing this type of hip,

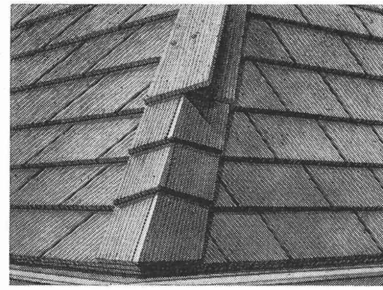


Figure 30. A Boston hip.

shingles of approximately the same size, six or more inches wide, should be sorted out. Two lines are marked on the shingles on the roof, five inches back from the center line of the ridge or hip, one on each side. The first shingle in the hip should be sawed across the butt to conform with the shingles at the eave line. It should then be nailed in place with one edge extending along the line previously marked on the roof. After the shingle is nailed, the edge of shingle projecting above the center line of the hip should be beveled or cut back. (See Figure 30.) The shingle on the opposite side of the hip should now be applied and the projecting edge cut back. The next two shingles are applied in reverse order. The starter course and end course of a hip should be doubled. Ridges may be constructed in a similar manner.

Nailing. Nails should be long enough to penetrate about three-fourths of the thickness of ordinary sheathing, and should be set $\frac{1}{2}$ to $\frac{3}{4}$ inch from the edge of the shingle and from 1 to 2 inches above the butt line of the covering course, two nails to each shingle. (See Figure 20.) Wide shingles should be split before laying. Nails should be driven flush, but not so hard that the head crushes the wood. Be careful with the last blow. Properly nailed shingles cannot be blown from a roof. (See page 19.)

The wide exposures obtained by double coursing are made possible by so-called "butt nailing," in which 5d small-head (Figure 19), zinc-coated nails are used to hold the butts of the shingles close to the wall. Two nails are used for each shingle, placed approximately $\frac{3}{4}''$ from each edge and 2" above the butt (Figure 31).

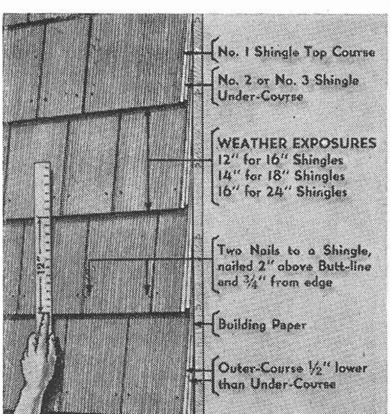


Figure 31. Double coursing, showing proper spacing of nails in butt nailing.

OVERROOFING WITH RED CEDAR SHINGLES

It is wasteful and unnecessary to remove the old shingles. These should be left in place and covered with new shingles. The result is double insulation against heat transmission, operating in both summer and winter, with a consequent saving of fuel during cold weather

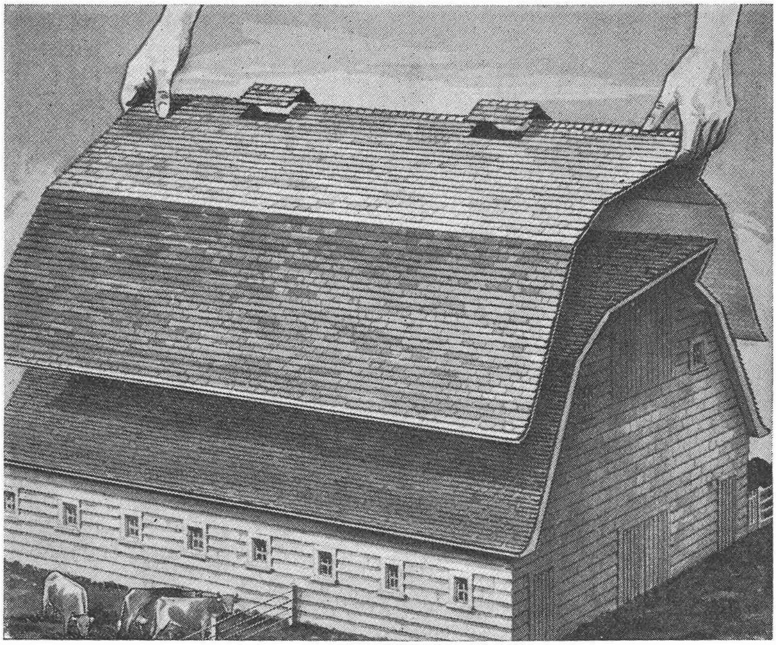


Figure 32. Reroofing over the old roof provides double insulation; increases strength.

that often reaches such proportions that in a few years the price of the new roof has been absorbed. The reduced heat transmission in summer adds vastly to home comfort. The double roof, moreover, is considerably stronger, so that a heavier snow load can be carried.

Overroofing has the further advantages of saving the labor of removing old shingles, avoiding litter and dirt, and retaining protection for building contents while the work is in progress, so that reroofing may be done at any season. It also avoids the danger, when reroofing a barn, of nails from the old roof falling into hay and thus getting into the stomachs of animals.

The method of reshingling illustrated and described has been demonstrated and proved to be practical. New red cedar shingles

Figure 33. Steps in reroofing.

will give fully as good service when applied over old shingles as on new roof decks.

In preparing an old wood-shingle surface to receive a new covering, all curled, badly warped, and loose shingles should be nailed flat and secure, and all protruding nails should be driven down.

THE FIRST STEP consists in cutting back the first course of the old shingles at the eaves. This may be done with a hatchet.

THE SECOND STEP consists merely in replacing the shingles that were removed with a strip of lumber 3 or 4 inches wide, nailed flush with the eave line.

THE THIRD STEP is to cut back the old shingles from the gable edges for a distance of 2 or 3 inches.

THE FOURTH STEP involves nailing a narrow strip of lumber, approximately as wide as the shingles that were removed, along the gable edge. This can be done as shingling progresses.

THE FIFTH STEP is to place a strip or strips of lumber in each valley to separate old metal from new and to make the valley level with the old shingle surface. Renew all other flashings. Remove old ridge and replace with B or C grade beveled siding, thin edge down.

THE SIXTH AND FINAL STEP is the application of new shingles over the old, using 5d or 6d hot-dipped, zinc-coated box or special over-roofing nails, and the final application of new combs or ridges.

A much finer and workmanlike job can be produced by applying new 1" x 6" or 1" x 8" strips over the old shingles, nailing them solidly to the rafters with eight-penny nails. These strips should be wide enough to cover the edges of two rows of the old shingles in order to bring them to an even surface for the new shingles.

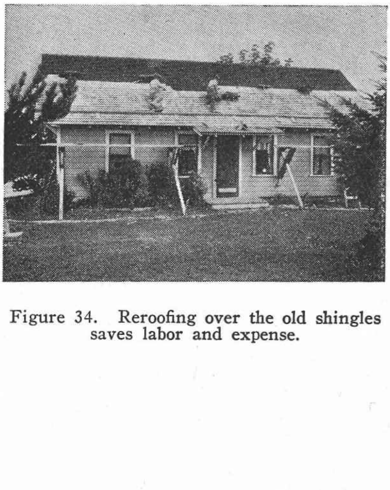


Figure 34. Reroofing over the old shingles saves labor and expense.

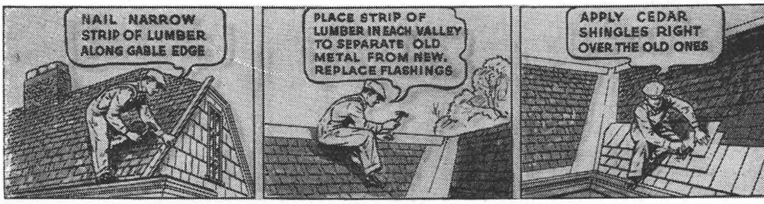


Figure 35. Steps in reroofing.

Another method of preparing old shingles for reroofing is as follows: The ends of the bottom course of the old roof are cut off or driven up so that the butts are flush with the fascia board. They are then hidden by nailing a piece of blind stop on to the fascia board, even with the top of the old shingles. On the gable ends the old shingles are cut off even with the bargeboard, and similar treatment with blind stop used or, if there was a moulding on the sides, this is removed and replaced, even with the top of the old shingles, after cutting them back.

Shingles can be quickly applied over roll roofing or composition shingles by first laying horizontal furring strips, 1" x 4", spaced the same distance center to center as the exposure of the new shingles. It may be necessary to remove some of the metal flashings when reroofing with red cedar shingles so as to provide a smooth deck, as any unevenness may cause breaks and waste. Metal under the shingles may permit accumulation of condensed moisture beneath them, causing a "weeping" roof and hastening decay of the roof deck and rafters.

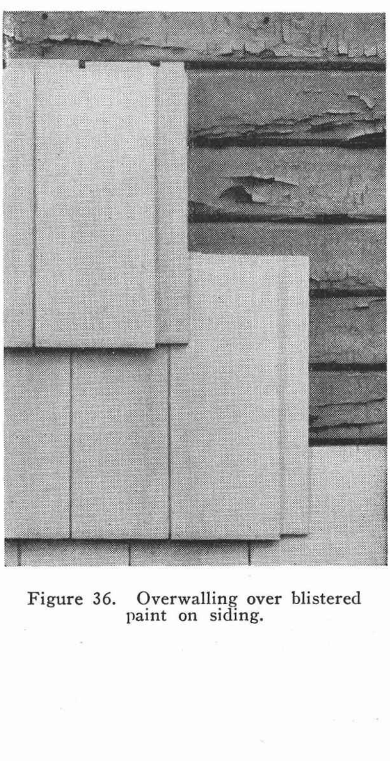


Figure 36. Overwalling over blistered paint on siding.

OVERWALLING WITH RED CEDAR SHINGLES

Just as old roofs can be covered with new wood shingles, so old side walls can be re-sided with new red cedar shingles.

Infiltration of air through the side walls often results in unsatisfactory shelter for the farm family or the livestock. Cold,

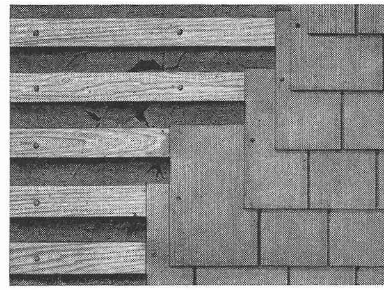


Figure 37. Strips and shingles over stucco walls.

drafty structures take their toll in increased heating costs and lowered production. Farm buildings that lack tight construction are often cold in winter and hot in summer. Such buildings may be greatly improved by overwalling the sides with red cedar shingles. Double coursing old walls improves the appearance of the building and insulates to a high degree against heat losses. Double coursing and wide spacing give a clapboard effect that is popular today.

To begin an overwall of wood shingles, run a line around the building with a spirit level. This will insure the proper running and spacing of all courses above and below the starting line. If old casings around windows and doors are thinner than the new walls, molding strips should be nailed flush with the edges of the old casings, to which the shingles should be joined. New flashings should be applied over window and door heads, and, on the exposed sides of the building, vertical flashing should be used between the casing and walls.

Overwalling on wood walls. On old wood walls of all types, whether bevel siding, novelty siding, or rustic, the shingles can be applied directly as on new sheathing. Building paper should be used as with new work. Various combinations of single and double coursing can be used to advantage in giving new lines to an old building (Figures 28-31).

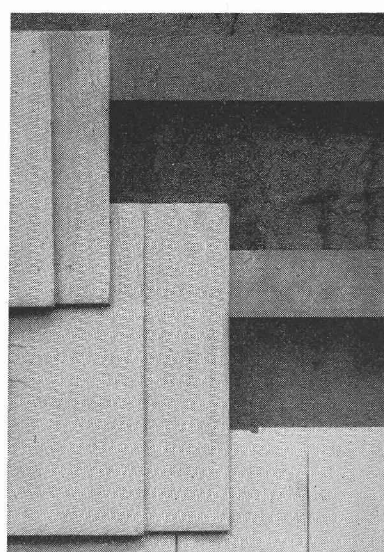


Figure 38. Overwalling over old brick.

Often the paint on the old wood siding or boards must be burned or scraped before repainting. Under these conditions it may prove economical to cover the old lumber side walls with red cedar shingles (Figure 36).

Overwalling over stucco. The application of shingles to old, cracked, leaky, and unsightly stucco walls is a simple matter (See Figure 37). Nailing strips should be attached with nails long enough to penetrate the stucco and the underlying sheathing. These nailing strips of 1" x 4" or 1" x 6" boards should have a center to center spacing equal to the exposure of the new side wall shingles. To these the shingles may be nailed directly as on new sheathing.

Stucco often can be easily and inexpensively removed and this is desirable if the material is loose and does not provide the proper support for the nails used in shingling. New paper can then be applied to the walls and the shingling can proceed as in new construction.

Overwalling over brick. Brick walls that are troublesome because of water absorption and infiltration through the brick may be easily covered with red cedar shingles. Vertical furring strips should be fastened to the window frames and to the walls through the use of anchors or special nails made for this purpose driven between the bricks.

To these furring strips nailing or shingle strips should be attached for the nailing of the outer shingled wall. The horizontal nailing strips should have a center to center spacing equal to the exposure of the shingles. (See Figure 38.)

VENTILATION

Vents, louvers, and air circulation. Care should be exercised in the architectural design of buildings to provide means for ventilating all enclosed areas at will through the use of vents, louvers, or windows. In hot weather, provision for such ventilation assures greater comfort, and in climates where sudden changes in weather conditions occur frequently, provision for ventilation to avoid too high humidities in enclosed spaces is distinctly necessary. A trap door behind such vents, to be closed in cold weather, reduces heat loss.

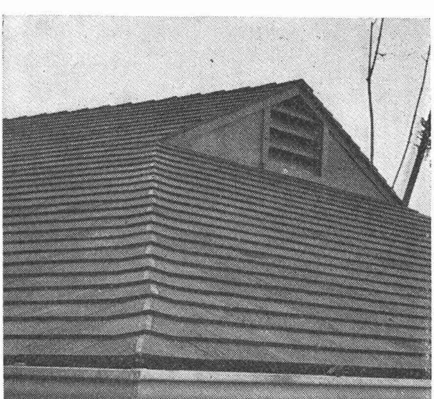


Figure 39. Simple "laced" hip and louvered gable. Louvers should be screened and provided with movable doors.

Porch attics and other enclosed spaces, if left unvented, are apt to develop "dry rot." All such enclosed spaces should be well ventilated, escape vents being placed near the tops of the gable ends (see Figure 39) or near the highest points reached by the rafters (Figure 40) with entrance vents in the ceilings, which can be concealed by fascia or cornice boards (Figure 40, inset). These openings should be provided with $\frac{1}{4}$" to $\frac{1}{2}$" galvanized screens, to prevent the entrance of birds. Fly screen is sometimes used but is likely to become clogged with dust and cobwebs and to rust out quickly. It is not recommended.

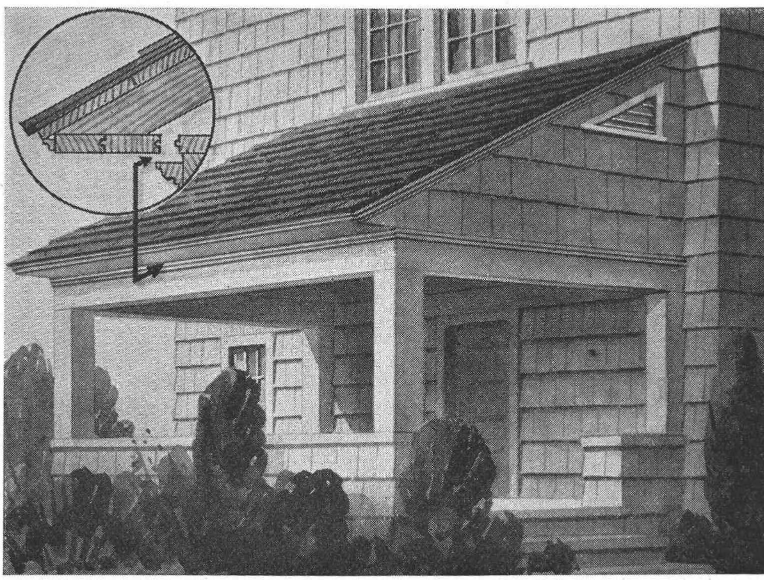


Figure 40. Porch attics should be vented and screened.

Many houses built on post and pier foundations are greatly improved in appearance and comfort if this area is enclosed. However, ventilation is particularly necessary for enclosed spaces under buildings having no basements. The supporting timbers in such places will quickly rot if the space is tightly closed and adequate cross ventilation is not provided. Vents or other openings must be placed on opposite sides of such closed spaces. The vents should be screened to keep out small animals and may be equipped with doors or removable covers for closing the openings in cold weather. Red cedar shingles make an excellent covering for this foundation, or skirt, wall.

STAINING AND PAINTING

The main reason for staining or painting red cedar shingles on roof or outside walls is to improve appearance. Red cedar shingles withstand the effect of exposure remarkably well and will last as long without stain or paint as with most of them.

Where appearance demands it, staining red cedar shingle roofs is recommended because of the economy of application and because staining causes no unequal stresses in the wood fiber, and no moisture pockets at the joints of the shingles. The roofs of all buildings in a farmstead group should harmonize in color.

Figure 41. (*Upper*) Thin with proper parts of turpentine and linseed oil. (*Center*) Pour soft white lead into mixing tub. (*Lower*) Stirring results in a uniform paint ready to apply.

A good shingle stain should be quite thin so that it may be applied evenly and quickly. Prepared shingle stains are supplied by stain and paint manufacturers at low cost. Red and brown colors have the best lasting qualities; blues and greens the least. Some shingle stains contain preservative materials such as coal-tar creosote; others contain none.

A simple formula for mixing shingle stain consists of one part turpentine, two parts boiled linseed oil, and coloring material.

Window and door casings, sashes, cornices, and other trim should be well protected from the elements with three coats of lead and oil paint.

Paste white lead and linseed oil, the principal paint ingredients, may be purchased in quantity, usually at a saving in cost, and kept in readiness for painting at odd times between regular farm work. These basic paint materials can be used for many

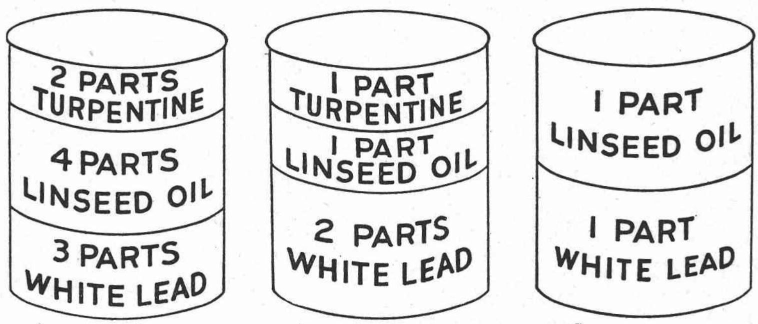


Figure 42. A. Primary coat; B. Second coat; C. Finish coat.

kinds of painting on the farm by mixing in turpentine and tinting material.

In mixing paint, pour a quantity of soft white lead into a clean, dry, water-tight receptacle; thin it by adding the right amount of turpentine, linseed oil, and tinting material; and stir thoroughly (See Figures 41 and 42).

Common sense dictates extreme care in the selection of ready-mixed paints. Scores of reliable manufacturers of mixed paints produce paint that can be used with safety and assurance. Most of them show the formula on the label.

More than half the cost of painting a building is for labor. Low-grade paint usually has less coverage. It may crack and peel away from the wood. Moisture then gets behind the paint film through the cracks, causing the paint to blister, and necessitating its removal, which is often costly, before a new coat of paint can be applied.

Always bear in mind that the priming coat on new wood is the foundation of the paint film. Brush the paint carefully into the wood and lay it on in an even film. When priming soft woods like red cedar, enough linseed oil should be added in the primer so that laps between stretches are not noticeable. Such laps are caused by oil soaking into the soft, porous wood, leaving the pigment on the surface.

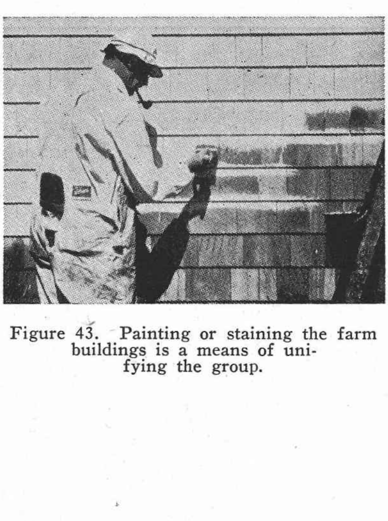


Figure 43. Painting or staining the farm buildings is a means of unifying the group.

The dipping method of painting or staining shingles is preferred. Shingles should be dipped to cover about two-thirds of their length and the surface should be thoroughly colored. Dipping should be done well in advance of laying so the shingles will be thoroughly dry as handling shingles wet with stain is sometimes hard on the workman. Some persons are seriously affected by contact with the solvents used in shingle stains. Red cedar shingles may be purchased already stained.

Painting flashings. Copper flashing does not require painting. Other flashing materials will last longer if protected with paint. The most satisfactory way to prepare galvanized sheet metal for painting is to allow it to "weather" for a few months. If it is desired to paint without delay, wash the surface thoroughly with vinegar, dry, and paint. Tin, if used, should be painted before it is applied. A good flashing paint may be mixed as follows: 1 part dryer, 1 part turpentine, 10 parts linseed oil, 12 parts red lead. An aluminum paint may be used when metallic appearance is desired or when heat reflecting properties are important.

SNOW AND WIND RESISTANCE

Wood shingles are the only roof covering that adds to the strength of the roof. All others are surfacing materials only, adding dead weight with no compensating increase in strength. The interlaced layers of shingles have a bridging effect, and bending stresses which develop when the roof is subjected to heavy snow and wind loads tend to be absorbed by the shingles which relieve the rafters of part of the load by transferring it to the side walls. This bridging effect is accompanied by a relatively small increase in weight as a square foot of shingles weighs less than two pounds. Roofs of half pitch or steeper will shed snow.

MOSS ON ROOFS

Control of moss on roofs can be accomplished very readily by spraying the roof with a 10 per cent solution of zinc chloride during dry weather. The moss absorbs the zinc chloride and is killed.

Spraying the roof with any standard strength of bordeaux or sprinkling dry bordeaux powder on slopes at the ridge kills moss.

A ridge roll of copper or galvanized sheet metal may discourage the growth of moss. There is evidence that this growth cannot get started in the presence of zinc or copper. On long slopes, however, the effect of the metal at the ridge may not extend the full length of the slope. When hips are present, galvanized hip shingles may help to extend the metallic influence to the lower parts of the roof. The ridge roll and galvanized hip shingles should not be painted.

ESTIMATING

The quantity of material required to shingle the roof or exterior walls of a building depends on several factors, such as (1) the size of the building, (2) the type of roof or design of the outside walls, (3) the exposure of the shingles, and (4) the method of application.

By exposure of shingles is meant the amount of the shingle that remains uncovered and exposed to the weather. This is determined by the steepness of the roof. In column 4 of Table 1, below, are listed the various recommended exposures of 16" shingles for typical roof pitches, and in Table 2, page 37, are listed the recommended exposures for 16-inch, 18-inch, and 24-inch shingles for use on side walls.

Roof. The area of a roof depends on the size, slope, and type. The usual types of roofs are the shed, gable, hip, gambrel, combination, arch, monitor, and half monitor (Figure 12). The methods of estimating the various types are explained on the following pages.

It is necessary to make an extra allowance for such items as ridges, hips, valleys, and the double row of starters at the eaves. An addition of one-half square foot should be made for each lineal foot of eaves. For the ridge, hips, and valleys an allowance of one square foot should be added for every lineal foot. Valleys and hips of equal length cancel each other and require few additional shingles as the cut sections from one may be used on the other.

Table 1. Roof Covering Capacity of Sixteen-inch Shingles.

1 Roof pitch	2 Rise per foot of run	3 Slope of roof	4 Exposure of shingles	5 Coverage for 4-bundle square	6 This factor times the horizontal area to be covered, including the overhang, gives the area of the slope
	Inches	*Degrees*	*Inches*	*Square feet*	*Secant**
Quarter pitch	6	26	3½	72	1.120
7/24	7	30	4	80	1.157
1/3	8	34	4½	90	1.200
3/8	9	37	5	100	1.250
5/12	10	40	5	100	1.300
11/24	11	42	5	100	1.356
Half pitch	12	45	5	100	1.415
13/24	13	47	5	100	1.473
7/12	14	49	5	100	1.537
5/8	15	51	5	100	1.600
2/3	16	53	5	100	1.667
3/4	18	56	5	100	1.800
5/6	20	59	5	100	1.943
7/8	21	60	5	100	2.016
Full pitch	24	63	5	100	2.236

* Also, this factor multiplied by the horizontal run, including overhang, gives length of rafter.

Walls. To compute the quantity of shingles required to cover exterior walls, subtract the number of square feet of openings from the total number of square feet of wall surface. Most estimates disregard openings of less than 10 square feet.

When wood shingles are placed on side walls, there are usually two thicknesses compared with three for roofs; therefore fewer shingles are required to cover 100 square feet. The usual exposure for 16-inch shingles on side walls is 7½ inches for single coursing and 12 inches for double coursing. A four-bundle square of 16-inch shingles laid 7½ inches to the weather will cover 150 square feet; laid 12 inches to the weather, it will cover 238 square feet. As the latter exposure requires double coursing, another four-bundle square of No. 2 or No. 3 shingles would be required for the under course.

Table 2. Side Wall Covering Capacities (Per 4-Bundle Square) in Square Feet for the Various Sized Shingles.

Single Course				Double Course			
Exposure inches	16″ shingles	18″ shingles	24″ shingles	Exposure double course	16″ shingles	18″ shingles	24″ shingles
7	140						
7½	150			11½	226		
8		146		12	238	238	
8½		156		13		248	
9			120	14		258	
10			132	15			200
11			146	16			212
11½			152				

NOTE: Quantities shown under "Double Course" are for each course.

Running-inch method of estimating. Another method of figuring the quantity of shingles required is the running-inch method.

The length of each row in inches times the number of rows, as determined by the exposure and size of area, will give the running inches of shingles required for roofs or side walls. Table 3 gives the number of running inches per four-bundle square.

Allowance should be made for starters, hips, ridges, and valleys, and deductions made for window and door openings.

Table 3. "Running inches" per 4-Bundle Square of Shingles.

Length	Thickness	Number of running inches per 4-bundle square	
		Green	Dry
Inches	*Inches*		
16	5 butts, 2	2960	2880
18	5 butts, 2¼	2664	2620
24	4 butts, 2	1996	1920

The shed roof (Figure 44). To compute the area, multiply the eave length (E) in feet by the length of the sloping rafter (S) in feet and add one-half square foot for each lineal foot of eave.

If length of slope (S) is not known, the area of the slope can be obtained by multiplying the area of the floor plan plus the overhang of the roof by the factor found in Column 6, Table 1, page 36.

EXAMPLE. If the length of the building is 18 feet, the width 8 feet, the overhang 1 foot on each side, and the rise 6" per foot, the area would be 20′ x 10′ x 1.12* = 224 square feet. Allowing an extra $\frac{1}{2}$ square foot per lineal foot for the double row at the eaves, we need $\frac{1}{2}$ x 20′ = 10 sq. ft. or a total of 234 sq. ft. area.

The recommended shingle exposure for this slope of roof is $3\frac{1}{2}$" (Column 4, Table 1). At this exposure, a 4-bundle square of shingles will cover 72 square feet (Column 5, Table 1), so by dividing the total area by the covering per square, $\frac{234}{72} = 3\frac{1}{4}$, or 3 squares and 1 bundle, we get the number of squares needed.

Figure 44. Shed roof.

* The factor for a roof with 6" rise per foot of run, Table 1, Column 6.

SIDE WALLS (Figure 44). The wall area of a building with a shed roof may be estimated as follows:

> Take the rear wall height (H) times the length (L) in feet, plus the front wall height (H) times the length (L) in feet, plus the rear wall height (H) times the width (W) in feet, plus the front wall height (H) times the width (W) in feet. Areas of openings are to be subtracted.

The net area divided by the coverage per square (see Table 2, page 37) gives the number of squares required for each layer or course. When double coursing is used the under course is usually No. 2 or No. 3 grade. Allowances for starter course are not made when double coursing is used.

EXAMPLE: If the length (L) is 18 feet, the width (W) is 8 feet, the front wall height (H) is 9 feet, and the rear wall (H) is 5 feet, and a 12-inch exposure is used with double coursing, the estimate is made as follows:

Rear wall height, 5 feet, times the length, 18 feet =	90 sq. ft.
Front wall height, 9 feet, times the length, 18 feet =	162 sq. ft.
Rear wall height, 5 feet, times the width, 8 feet =	40 sq. ft.
Front wall height, 9 feet, times the width, 8 feet =	72 sq. ft.
Total wall area	364
Deduct door area 3′ x 7′	21
Net wall area	343 sq. ft.

The net area 343 square feet divided by 238, the coverage per square for 12-inch exposure in Table 2, equals 1.44 or 1 square and about 2 bundles. As the under course requires the same amount of shingles we would order 1½ squares of No. 2 or No. 3 undercoursers and 1½ squares of No. 1 or No. 2 for the top course.

The gable roof (Figure 45) is a ridge roof ending in a gable. To estimate the area for shingles, multiply the ridge length (R) by the sloping rafter length (S), multiply by two, and make allowance for the ridge and the double row at the eaves. If length of slope (S) is not known, use the factor in Column 6, Table 1.

EXAMPLE. If the width of the building (W) is 24 feet and the overhang is 1 foot on each side (total 26 feet) and the eave length (E) is 32 feet, and the rise is 9″ per foot, to find the area of roof multiply 26′ x 32′ x 1.25* = 1040 square feet. Adding one-half square foot for each lineal foot of eave, ½ x 64 = 32 square

* The factor for a roof with a 9″ rise to 12″ run. Table 1, column 6.

feet, and 1 square foot for each lineal foot of ridge, $1 \times 32 = 32$, we find a total of $1040 + 32 + 32 = 1104$ square feet.

We see in Table 1, page 36, that shingles for this slope of roof can be exposed 5" and that one square will cover 100 square feet, so by dividing the total area, 1104 square feet, by 100, the coverage per square, we find $\frac{1104}{100} = 11.04$ squares. As the bundle is the smallest unit available, we would order eleven squares and one bundle, 11.25 squares.

SIDE WALLS (Figure 45). In figuring the area of side walls, multiply the height of the side wall shingle area (H) of the building by the sum of the length of walls (2L + 2W), add the area of the two gables* (W) x (H of gable) and subtract the area of door and window openings.

EXAMPLE. If width = 24 feet, length = 32 feet, the side wall height = 4 feet, and the gable height = 9 feet,

side wall area = (2 x 24) + (2 x 32) x 4 = 448 square feet,
gable area (2 gables) = 24 x 9 = 216 square feet.

If allowance of 1 square foot is made for waste at the sloping junction of the wall and roof, we would add 1 x 24 = 24 square feet, and ½ square foot per lineal foot of wall for starters ½ x 112 = 56 square feet. Total 448 + 216 + 24 + 56 = 744 square feet.

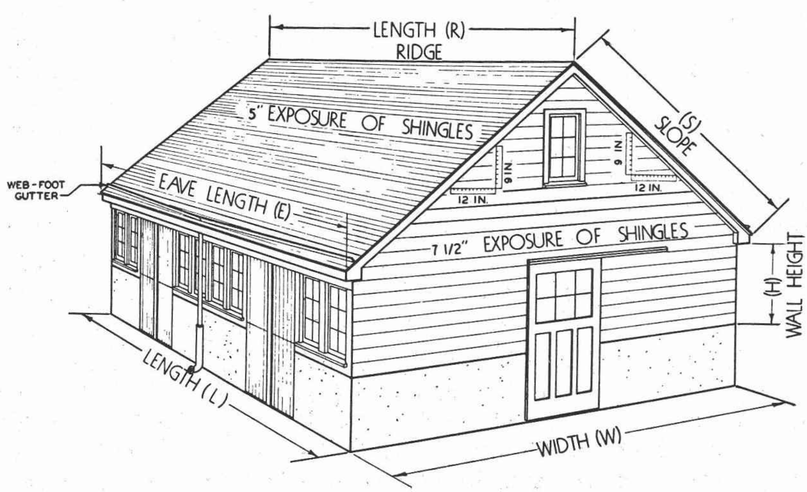


Figure 45. Gable roof.

* (½W) × (H of gable) = area of one gable.

Subtracting (side wall, 8 windows and 4 doors) 4′ x 32′* = 128
(2 end doors 4′ x 4′)† 2 x 4 x 4 = 32
160

Required shingle area = 744 — 160 = 584 square feet.

Sixteen-inch shingles with $7\frac{1}{2}$″ exposure will cover 150 square feet per 4-bundle square (Table 2). As 16″ shingles are normally sold in terms of 4-bundle square, this would require $\frac{574}{150} = 3\frac{3}{4}$— three squares and three bundles.

The hip roof (Figure 46) is a ridge roof that slopes from all four walls to the center. This type of construction eliminates the gable ends.

To figure the quantity of shingles for the roof, find the area of the two triangular end sections. The slope (S) times the eave width (EW) will give the area of the two end slopes. Add the eave length (E) to the ridge length (R) and multiply by the slope (S) to find the area of the two side slopes.‡ Add to this $\frac{1}{2}$ square foot per lineal foot of eaves for the double course and one square foot per lineal foot of ridge and hip to find the total area in square feet.

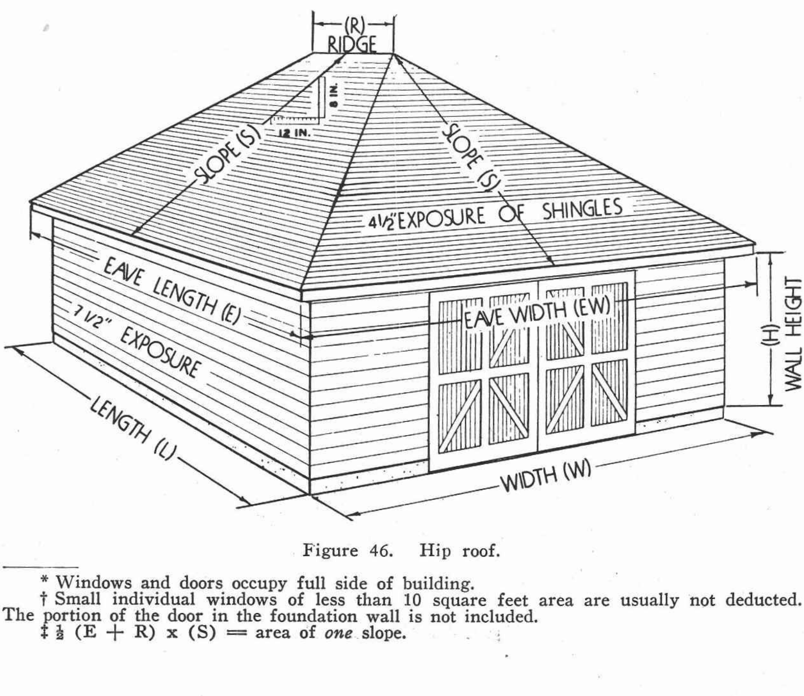


Figure 46. Hip roof.

* Windows and doors occupy full side of building.
† Small individual windows of less than 10 square feet area are usually not deducted. The portion of the door in the foundation wall is not included.
‡ $\frac{1}{2}$ (E + R) x (S) = area of *one* slope.

From Table 1 we find that for a (third pitch) slope of 8" rise to 12" run an exposure of $4\frac{1}{2}$" is recommended and a 4-bundle square of 16-inch shingles will cover 90 square feet.

The total area of the roof in square feet with allowance for starters, ridges and hips added, divided by 90 will give the number of 4-bundle squares of 16-inch shingles required.

THE WALL AREA is equal to the wall height (H) times the sum of the wall lengths (L) and width (W) times two. To this is added $\frac{1}{2}$ square foot per foot for starters at the bottom. The area of openings is deducted from the total area. If the maximum exposure for 16-inch shingles is used ($7\frac{1}{2}$"), the number of 4-bundle squares is found by dividing the total area by 150, the area covered by a four-bundle square laid $7\frac{1}{2}$ inches to the weather, single course (Table 2).

The gambrel roof (Figure 47) consists of 2 sets of slopes and the areas should be figured separately as the exposure on the upper slope differs from that on the lower.

The upper slope (S_1) times the ridge length (R) times 2 gives the area of the 2 top sections. As the flared eaves are usually given the same slope as the upper rafters, they can be figured with this section. Eave length (E) times the slope S_3 x 2 will give that area. To these two main areas should be added 1 square foot per lineal

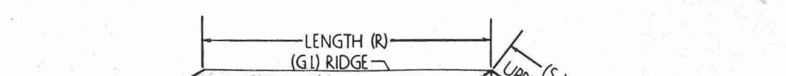


Figure 47. Gambrel roof.

foot of ridge plus ½ square foot per lineal foot of length for starters at the hip and another ½ square foot for double row at the eave.

Table 1 shows that, for a 7/24 pitch, a 4" exposure is recommended and a 4-bundle square will cover 80 square feet. The area found for the upper slope, plus allowances, divided by 80 will give the number of squares required.

The lower slope (S_2) times the eave length (E) times 2 gives the area of these sections. To this is added the allowance for starters 2 x (E) x ½. Table 1 shows that, for a 12/24 pitch, a 5" exposure is satisfactory and a four-bundle square will cover 100 square feet. To find the number of squares required, divide by 100.

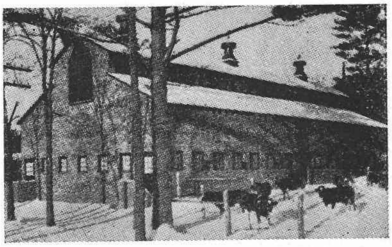


Figure 48. Monitor roof.

If the barn is 40 feet long, an additional 80 square feet will be needed for starters, hips and ridges. From Table 1, page 36, we find that for a 4-inch exposure a square of shingles will cover 80 square feet and, as 80 square feet is the allowance necessary, an additional square of shingles would be required to cover them.

Galvanized hip flashing is recommended for this type of roof.

The wall area can be estimated by the method given below for the Oregon arch roof.

Monitor roof (Figure 48). In estimating the shingles required for monitor roofs a combination of previously described types is used. The top section is figured as a gable roof and the two lower units are estimated as two shed roofs.

Oregon arch roof (Figure 49). The most modern type of roof is the Gothic arch. It provides a large unobstructed mow space, is pleasing in appearance, and is strong in construction if properly designed and built.

The change from a nearly vertical wall on the side to a flatter slope at the top of the roof requires a different exposure of shingles if an economical, efficient roof covering is desired. As all of these roofs are made from patterns, it is an easy matter to scale (measure) the lengths of slopes, S_1, S_2, etc., on the pattern drawing for the various pitches and multiply by the ridge length (R) and divide by the coverage per square of each section. (See Table 1.) Multiplying each of these areas by two gives the total for the roof. Allowance should be made of ½ square foot per lineal foot of eave for double row at eaves. A wide galvanized-iron ridge is recommended for this type of roof.

THE WALL AREA is found by multiplying the wall height (H in feet) by two times the length, added to two times the width (W), and adding to this the gable area. The gable area is found approximately by multiplying the width (W) by ¾ the height of the gable and doubling for the two ends. This gable area varies for the different types of arches so only an approximate figure can be given. Areas should be deducted for windows and doors. The area found, divided by the coverage per 4-bundle square of shingles, Table 2, will give the number of squares required.

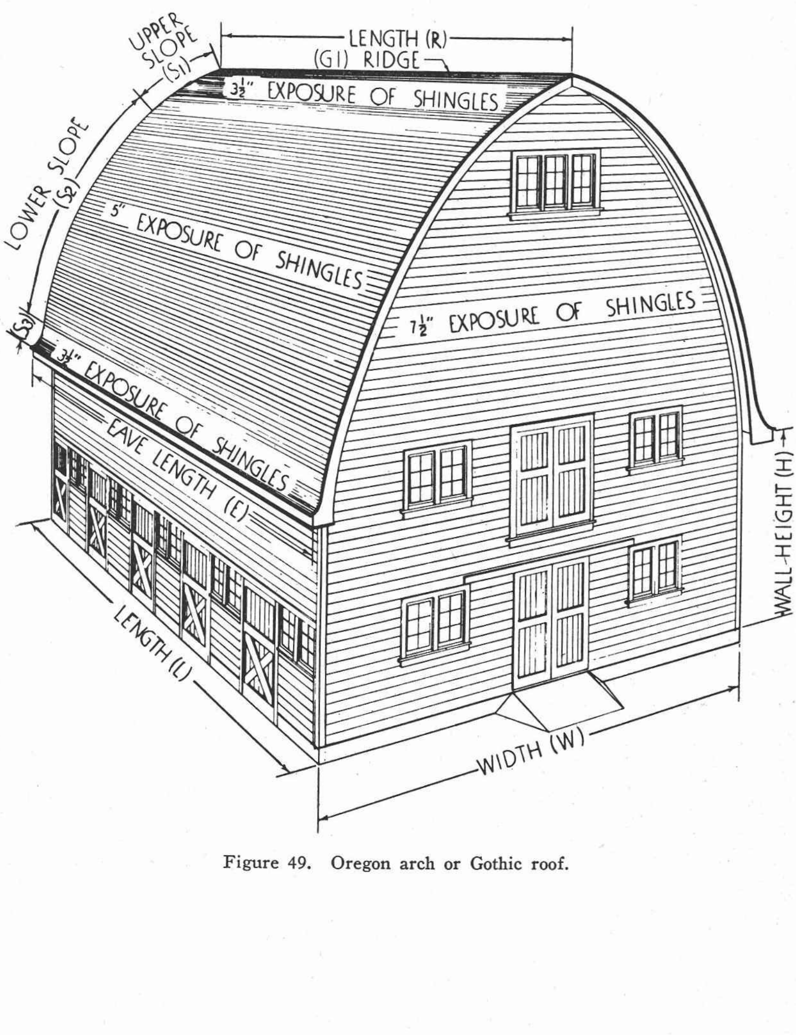


Figure 49. Oregon arch or Gothic roof.

Combination roof (Figure 50). The object of this type of roof is to afford more head room on one side and more direct sunlight and to reduce the average ceiling height. The construction is similar to the gable roof except that one wall plate is lower than the other. The area is found by multiplying the eave length (E) by the *short* slope (S_1) and adding to this the area found by multiplying the ridge length (R) by the *long* slope (S_2), allowing $\frac{1}{2}$ square foot per lineal foot for the double row along the two eaves and 1 square foot per lineal foot of ridge. If the pitches differ, requiring different exposures of shingles on the two slopes, it will be necessary to keep the two areas separate and then divide by the coverage per square for their respective exposures. (See Table 1.)

THE WALL AREA is found by multiplying the front wall height (H_1) by the length (L), adding the rear wall height (H_2) times the length (L), and adding the area of the *two* ends, found by taking the ridge height plus the front wall height, multiplied by the *run* of the front slope, and adding to this the area of the rear part found by taking the ridge height plus the rear wall height, multiplied by the *run* of the rear slope. Allow $\frac{1}{2}$ square foot per lineal foot for starters all around. Subtract areas of doors and windows. For the exposure in the figure, $7\frac{1}{2}$ inches, the number of squares required may be found by dividing the area in square feet of wall by 150 (See Table 2), the coverage of a 4-bundle square of 16-inch shingles, single course.

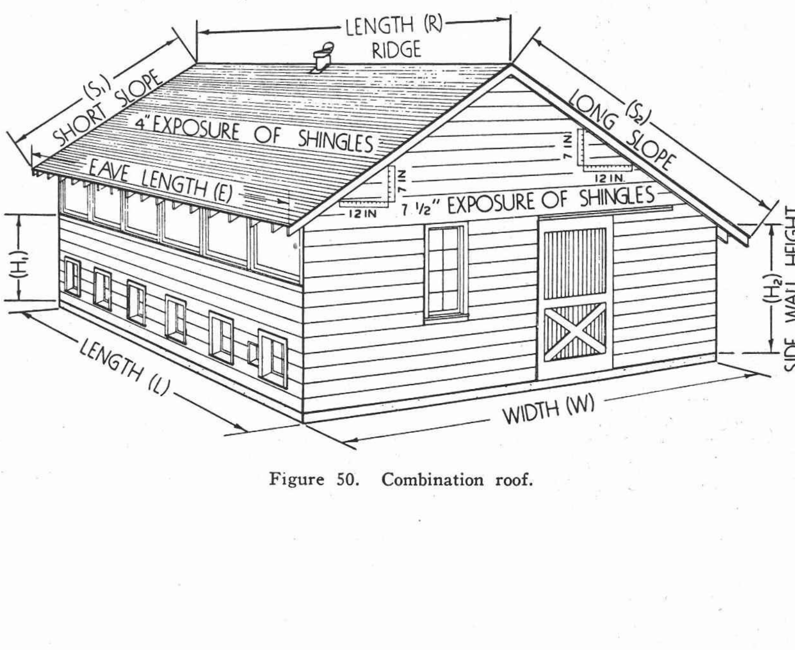


Figure 50. Combination roof.

Nails. The quantity of nails required will be determined by the number of squares of shingles needed and the size, grade, and exposure to be used. Selecting the shingle size, grade, and exposure will determine the weight of shingle nails required and this multiplied by the number of squares will give the quantity of nails (Figure 19).

Table 4. Approximate Weight of 3d Hot-Dipped, Zinc-Coated Nails Per Square of Random-Width Shingles, for Weather Exposures Given.

	3½-inch exposure		4-inch exposure		4½-inch exposure		5-inch exposure	
16-inch shingle	Weight Lbs.	Oz.	Weight Lbs.	Oz.	Weight Lbs.	Oz.	Weight Lbs.	Oz.
Grade 1	2	14	2	8	2	3½	2	0
Grade 2	3	10	3	3	2	13½	2	9
Grade 3	4	2	3	12	3	5	3	0
18-inch shingle	4-inch exposure		4½-inch exposure		5-inch exposure		5½-inch exposure	
Grade 1	2	8	2	3½	2	0	1	13
Grade 2	3	3	2	13½	2	9	2	5
Grade 3	3	12	3	5	3	0	2	11
24-inch shingle	6-inch exposure		6½-inch exposure		7-inch exposure		7½-inch exposure	
Grade 1	2	4	2	1	2	0	1	14
Grade 2	2	12	2	9	2	7½	2	5
Grade 3	3	0	2	12	2	10½	2	8

NOTE: The above figures are for new roofs. For overroofing, as larger nails are used, increase weights of nails needed two-thirds for 16″ and 18″ shingles and three-fourths for 24″ shingles.

Table 5. Approximate Weight of 5d Hot-Dipped, Zinc-Coated Nails Per Square of Random-Width Shingles When Applied to Side Walls, for Weather Exposure Given. (Read note below before using table.)

16-inch shingle	5½-inch exposure Weight Lbs.	Oz.	6-inch exposure Weight Lbs.	Oz.	6½-inch exposure Weight Lbs.	Oz.	7-inch exposure Weight Lbs.	Oz.	7½-inch exposure Weight Lbs.	Oz.
Grade 1	3	0	2	12	2	8	2	6	2	3
Grade 2	3	12	3	7	3	2	2	15	2	12
Grade 3	4	5	4	0	3	11	3	6	3	1
18-inch shingle	6-inch exposure		6½-inch exposure		7-inch exposure		7½-inch exposure		8-inch exposure	
Grade 1	2	12	2	8	2	6	2	3	2	0
Grade 2	3	7	3	2	2	15	2	12	2	8
Grade 3	4	0	3	11	3	6	3	1	2	11
24-inch shingle	8-inch exposure		9-inch exposure		10-inch exposure		11-inch exposure		12-inch exposure	
Grade 1	2	0	1	13	1	10	1	8	1	5
Grade 2	2	6	2	4	2	0	1	12	1	10
Grade 3	2	9	2	6	2	3	1	15	1	12

NOTE: The above figures are for new single-coursed side walls. For over-walling, as 6d nails are needed for 24-inch shingles, increase the corresponding weights one-half. For double-coursing with butt-nailing, small-headed 5d nails are required, and therefore 10 per cent may be deducted from weights as listed. A 12-inch exposure will require half as many nails as a 6-inch exposure, a 14-inch half as many as a 7-inch, etc.

INDEX

Air circulation, 31
Air infiltration, 14
Application of shingles, 22
Arch roof, 12, 43, 44

Beef cattle barns, 24
Boston hip, 25-26
Box gutter, 18
Building paper, 14
Butt nailing, 26

Car port, 5
Cement coated nails, 18
Chimney, 15, 16, 17
Choosing proper exposure, 25
Combination roof, 12, 45
Commercial standards, 20-21
Community halls, 5
Community or central hog house, 7
Condensation, 9, 29
Copper, 15, 35
Copper nails, 18
Copper ridges, 35
Corners, 24
Counter flashing, 16
Coursing, 24-37
Covering capacity of shingles, 36, 37
Cricket, 16, 17

Dairy buildings, 6
Dipping shingles, 34
Double coursing, 24, 25, 26
Down spouts, 18
Drip from gables, 17
Dry rot, 32

Estimating, 36
  Arch roof, 43
  Combination roof, 45
  Gable roof, 39
  Gambrel roof, 42
  Gothic roof, 43
  Hip roof, 41
  Monitor roof, 43
  Nails, 46
  Shed roof, 38
Exposure of shingles, 11, 15, 25

Farm building essentials, 4
Farm house, 4
Farm poultry housing, 6
Farm shop, 10
Farrowing houses, 7
Federal standards, 20
Fire, 10
Flashing, 15
Flat grain shingles, 23
Foundations, 9, 32
Full pitch, 10

Gable roof, 12, 39, 40
Galvanized nails, 18, 46
Galvanized ridges, 15, 35
Galvanized sheet metal, 15
Gambrel roof, 12, 14, 42
Garage, 4
Gothic arch roof, 12, 43, 44
Grades of shingles, 20
Grain storage, 8
Gutters, 17, 18

Half-monitor roof, 12
Half pitch, 10
Hay storage, 9
Heat loss, 13
Hip roof, 12, 41
Hips, 25, 26

Hog houses, 7

Implement sheds, 10
Insulation, 13

Laced corners, 24
Laced hip, 31
Lambing shed, 13
Laying house, 13
Lead flashing, 17
Length of shingles, 21
Louvers, 31

Machinery shed, 10
Manure tanks, 7
Milk houses, 6
Milking barn, 6
Mixing paints, 33
Moisture condensation, 9, 29
Monitor roof, 12, 43
Moss on roof, 35

Nailing, 19, 26
Nailing strips, 14, 29, 31
Nails, 18, 19, 46
No. 1 shingles, 21
No. 2 shingles, 22
No. 3 shingles, 22

O.G. gutter, 18
Open sheathing, 11, 13, 14, 24
Oregon arch roof, 12, 43, 44
Overroofing, 27
Overwalling, 29
Overwalling on wood walls, 30
Overwalling over brick, 31
Overwalling over stucco, 30

Painting, 33
Painting flashings, 35
Pitch of roofs, 10
Plan service, 2
Plywood sheathing, 14, 23
Porches, 32
Potato storage, 8
Poultry housing, 6

Reroofing, 27
Ridges, 25
Rise, 10
Roof construction, 10, 11, 12
Roof pitches, 10, 11, 12
Roof slopes, 10, 11, 12
Roof types:
  Arch, 12, 44
  Combination, 12, 45
  Gable 12, 39, 40
  Gambrel, 12, 42
  Hip, 12, 41
  Half-monitor, 12
  Monitor, 12, 43
  Shed, 12, 38
Run, 10
Running-inch method of estimating, 37
Running inches per bundle, 37

Selection of shingles, 22
Sheathing, 11, 13, 14, 23
Shed roof, 12, 38
Sheep housing, 8
Single coursing, 24
Shingle exposure, 11, 15
Shingle grades, 20, 21
Shingle nails, 18, 19, 46
Shop, 10
Side lap, 22
Slope, roof, 10, 11

INDEX—*Continued*

Snow resistance, 35
Spacing of shingles, 22
Spacing of nails, 19, 26
Span, 10
Spontaneous combustion, 10
Square of shingles, 36, 37
Staining, 33
Starter rows, 22
Storage buildings, 8

Thickness of shingles, 20, 21
Third pitch, 12
Tight sheathing, 11, 13, 14
Tin flashings, 15

U. S. Dept. of Commerce standards, 21

Valleys, 16
Vegetable storage, 8
Ventilation, 31, 32
Vents, 31

Wall areas, 37, 39, 40, 42, 44, 45
Water stop, 16
Webfoot gutter, 18
Weight of shingles, 35
Wind resistance, 35
Windows, 24, 25

Zinc, 35
Zinc-coated nails, 18, 19

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