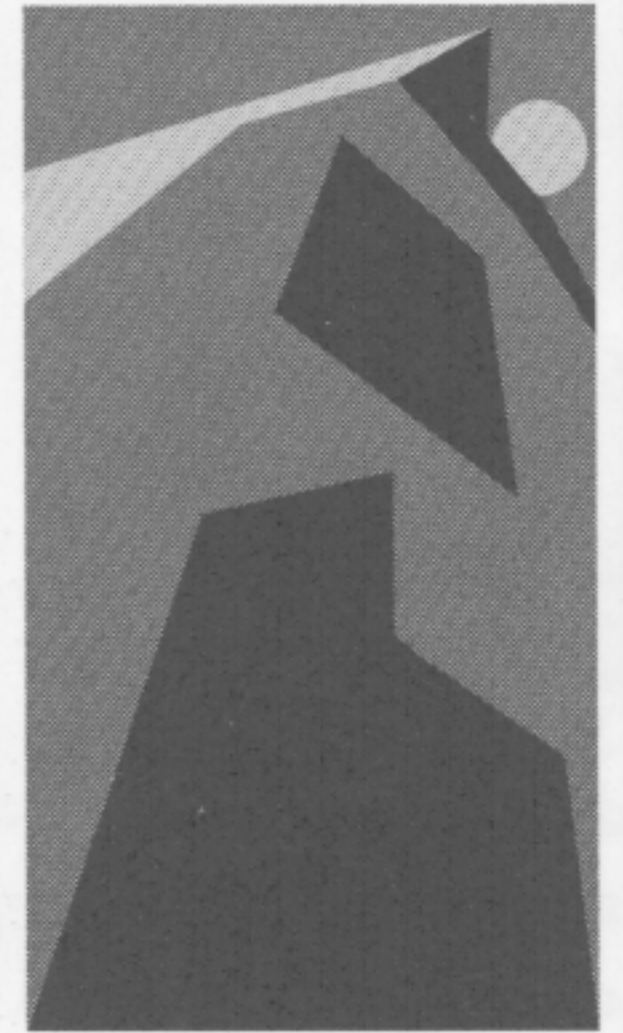


BARN



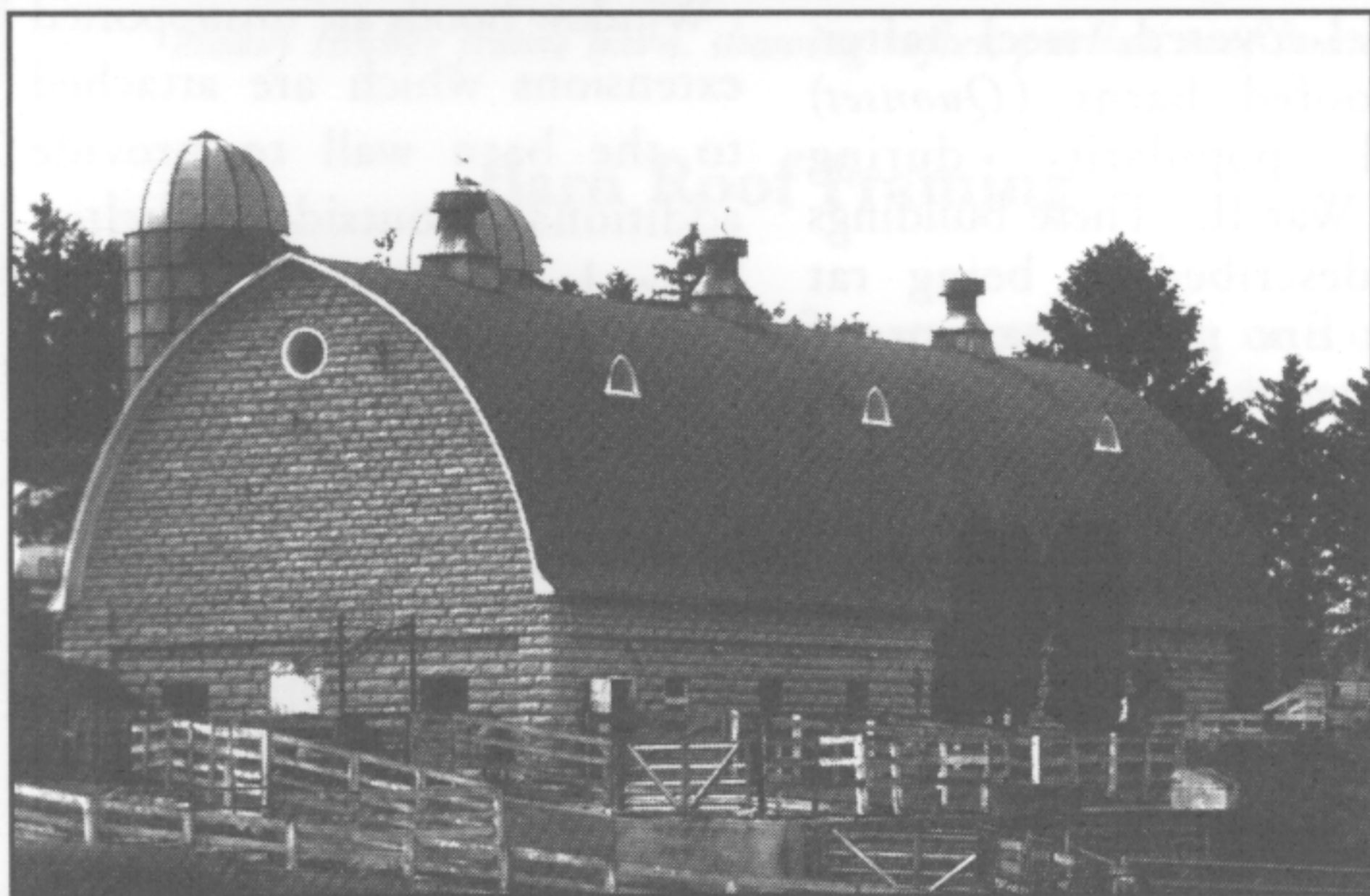
AGAIN!

A NATIONAL PROGRAM
TO PRESERVE HISTORIC
FARM BUILDINGS

BARN AID SERIES NUMBER 4, BARN ROOFS

The National Trust for Historic Preservation
Successful Farming Magazine

BARN ROOFS



Because of its sheer size and visibility, the roof is a distinctive architectural feature of most historic barns. It is also the single most important element in protecting the barn from damage from water, snow and wind. Because of their size and height, barn roofs present particular repair and maintenance challenges. Roofing materials don't last forever, and if you own an old barn your roof will eventually need to be replaced.

Water and Roofs

Moisture is the number one threat to building materials in historic structures. Weathering from rain, snow, ice, wind and sunlight will compromise a roof's integrity over time. A leaky roof in turn allows water to rot rafters, beams and other structural members of the barn. Incoming water can also damage material and equipment which are stored in the barn. Providing a good roof is the first and most important step in rehabilitating and

maintaining a barn. If you don't have a good roof, you don't have a sound barn!

A History of Roofing Materials

The oldest commonly used material for barn roofs was hand-split, rustic cedar shakes, which were widely used prior to the mid-19th century. These rough shakes were replaced

in the 1870s with the smoother, more uniform, machine-milled wood shingles which are still used today.

With a life expectancy of one hundred years, slate provided many of the earliest American barns with the greatest longevity and allowed the barn builder artistic license with the barn roof design. Imbricated and patterned slate displaying the farmer's initials and construction date conveyed the status and pride of the barn owner. Since slate is relatively heavy, it was generally used in areas where it could be shipped by rail.

By the early 1870s, standing seam metal, flat-seam tin-plated iron or steel, zinc-plated and copper roofs were used as substitutes for wood or slate. These roofing materials had the advantage of being rugged, fire resistant and easy to maintain. Decorative metal shingles were popular in the late nineteenth century.

The roof, because of its sheer size and visibility, is a distinctive design element of most historic barns.

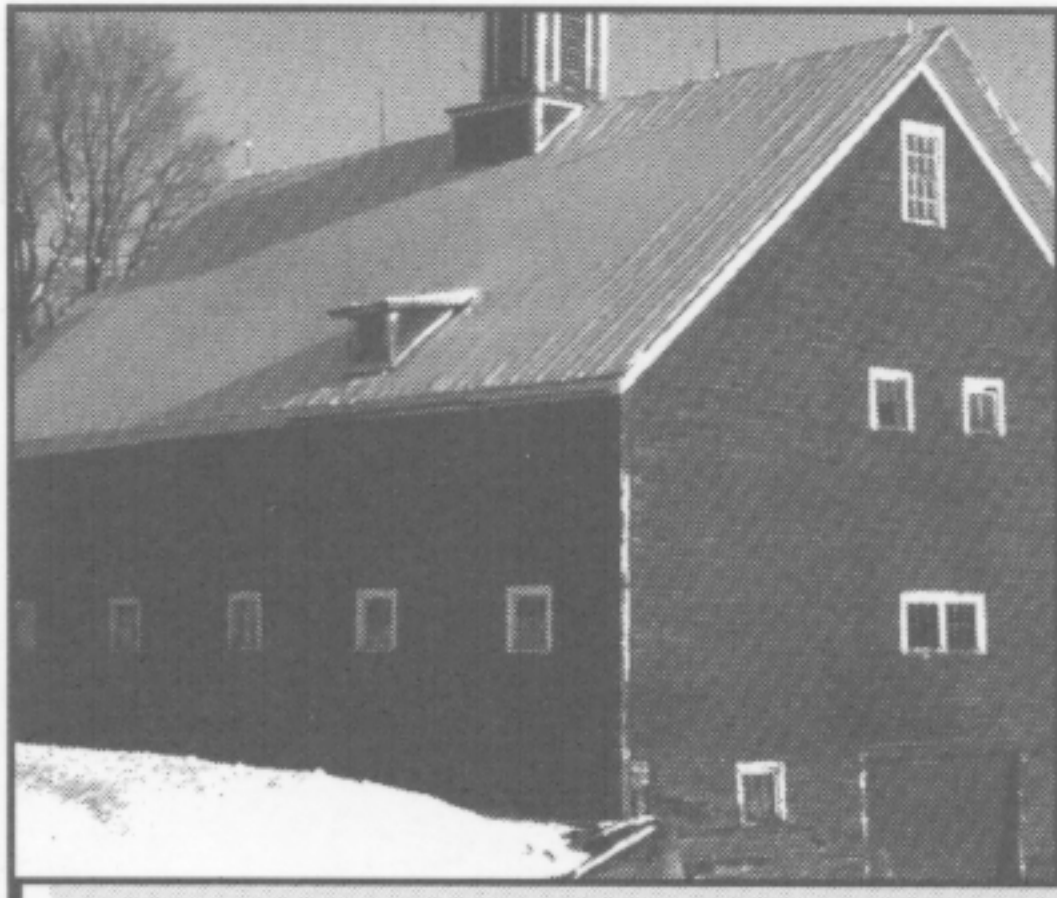
Both flat and curved clay roofing tiles were used in the late 19th and early 20th centuries. Although quite durable, tile roofs can be damaged if hit by tree branches or walked upon.

By 1960, asphalt or fiberglass shingle roofs became increasingly popular among farmers. Asphalt shingles are constructed of heavy felt which is saturated with asphalt and covered with mineral grit. They wear very well, and weigh from 205 to 390 pounds per roofing square (100 square feet). Fiberglass shingles are similar to asphalt, but are lighter and easier to apply.

Roof Longevity in Years *

Material	Life Expectancy
slate	80 to 100
cedar shingles/shakes	40 to 50
metal	50 to 60
asphalt/fiberglass shingles	20
rolled roofing	20

* Roof slope, orientation, UV exposure, installation techniques and maintenance also affect the longevity of the roof



Gable Roof Types

Because they are such large, distinctive features, roof types are often used to identify barns. The simplest and most common roof form is the gable. Also called the saddle roof or ridge roof, the gable roof has a single ridge line at the top and slopes evenly down on either side. Sometimes sheds with different roof pitches are attached to the sides of a gable-roofed barn, creating a shed-roof or broken gable roof barn. Gable roofs are easy to construct. A medium-pitch gable roof is one of the most wind-resistant roof shapes.

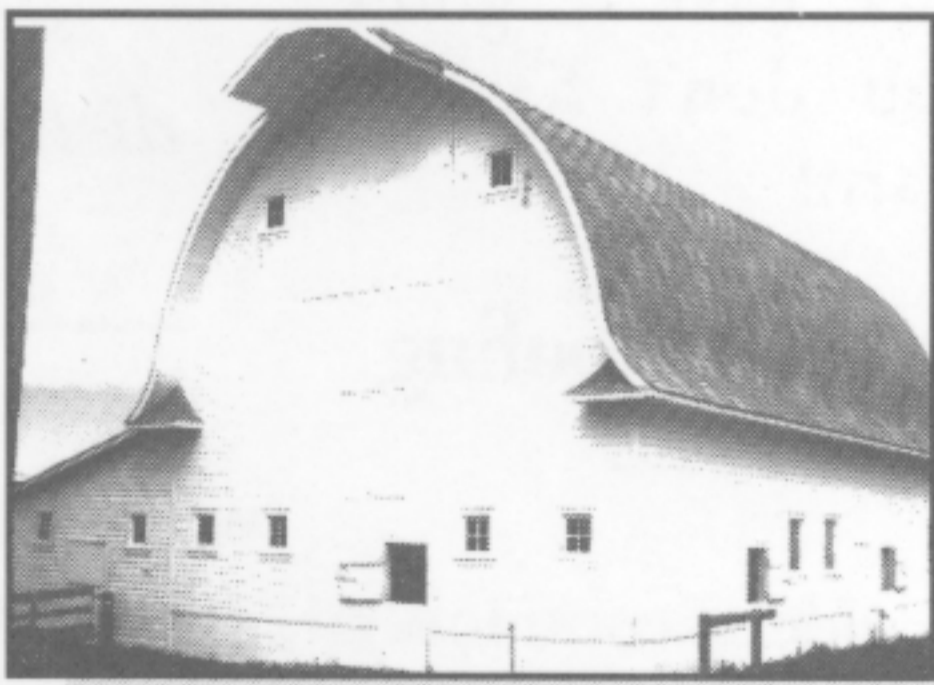
The availability of dimension lumber in the second half of the 19th century made possible the



Gambrel

development of the gambrel roof. Gambrel roof barns have a dual pitch that allows for a greater loft capacity than the gable roof. This roof type is named for its resemblance to a butcher's hook (*gambrel* in French). Gambrel roofs that have a slight flare at the eaves are called Dutch gambrel roofs. The flare directs rainwater away from the base of the wall, helping protect the barn foundation.

Beginning in the 1920s, the round roof was developed and found to be more efficient than the gambrel in providing loft storage space. Also known as the Gothic, arched or rainbow roof, depending on the width of the curve, it was constructed of a series of laminated 1" x 4" curved rafters.



Gothic roof with hay hood

Less commonly found is the hipped roof, which slopes on all four sides and provides the least loft area. Variations include the hip on gable where the upper part of the roof is gable and lower roof is hipped; or the snug Dutch where the roof is a gable with its upper corners beveled.

Saltbox roofs have one roof slope longer than the other. Generally, both slopes have the same pitch. Often a gable-roofed barn with one

attached side shed will give the appearance of a saltbox roof.

The conical or dome roof was used for the drying house in hop barns, on silos, or on round or octagonal barns which were promoted as efficient designs during the late 19th and early 20th centuries.



Conical

Steel-covered, steel rafter, arch-roofed barns (*Quonset*) gained popularity during World War II. These buildings were described as being rat proof, fire proof, sag proof and age resistant. Repeated expansion and contraction, however, caused eventual leaks around fasteners.

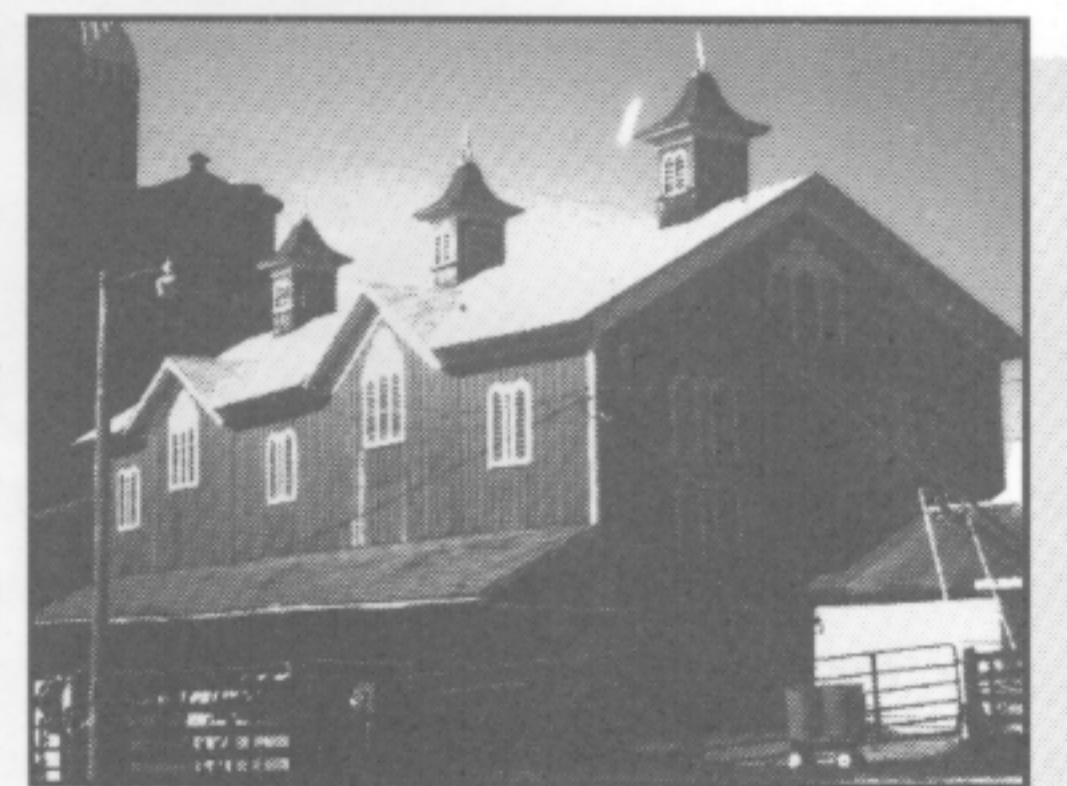
Rooftop Features

Rooftop features on barns are both functional and ornamental. Many barns display weather vanes and lightning rods along their roof lines. Roof ventilators called cupolas were first introduced to barns in the Connecticut Valley in the early 1800s. They were designed to provide ventilation to the hay loft, to facilitate drying of hay and reduce the chance of fire.

Cupola design often distinguished one barn from another. Some cupolas feature Victorian-style louvers on their four sides.

A dormer is a framework containing a window or vent, that projects horizontally through the roof. Dormers interrupt the roof line and allow light into the loft area of the barn. They serve a dual function of providing ventilation and allowing access for loading the hayloft. Loft ventilation can also be provided by leaving the uppermost triangle of the gable wall open on the end facing away from the prevailing wind.

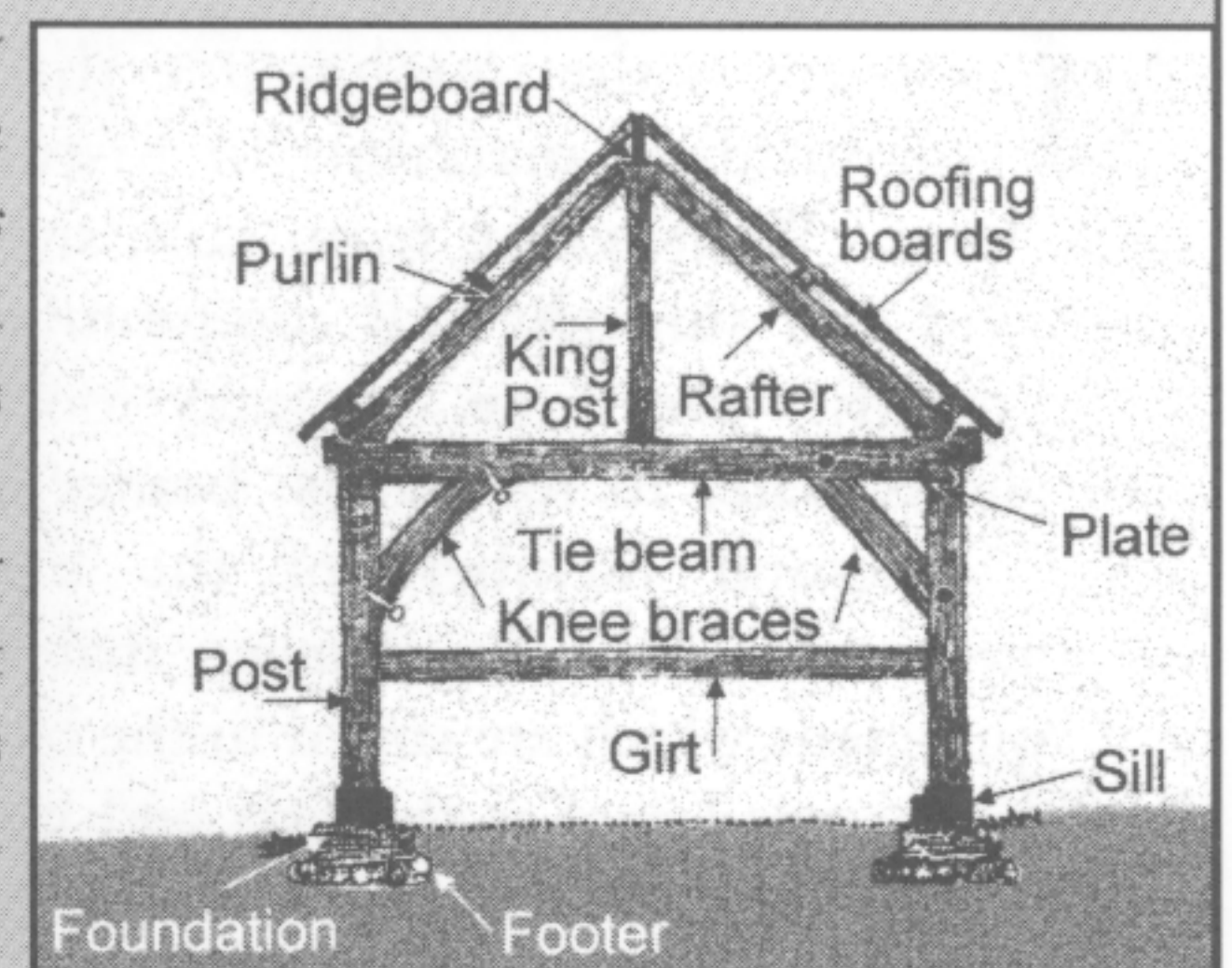
Window hoods are unsupported extensions which are attached to the barn wall to provide additional outside shelter. When located at the ridge of the barn roof, they are called hay hoods. They were designed to protect and support pulley attachments used to load hay into the loft, and to provide weather protection for the loft door.

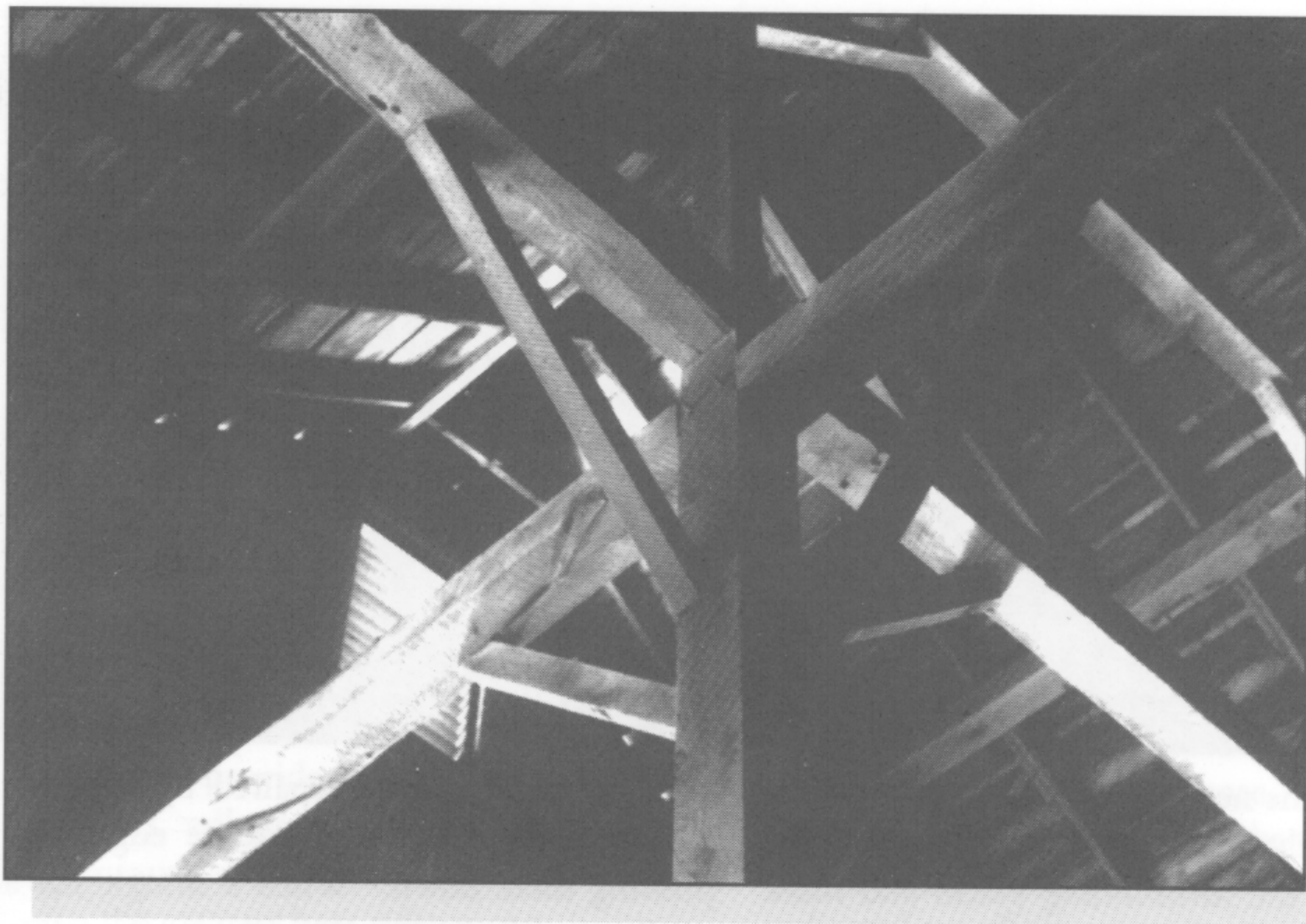


Louvered cupolas decorate the top of the barn and provide ventilation for the haymow.

Terms Used in Roof Structures

Perhaps the best way to begin an evaluation of roof repair and replacement options is to briefly review some terms commonly used when referring to roof structure. The *ridge board* is the highest horizontal member of a roof assembly. The top ends of the rafters are attached to it. *Rafters* are the sloping frame members of the roof that support the sheathing, roof covering materials, and all other loads. A *purlin* is a board placed horizontally across the roof rafters. *Roof boards* are the members perpendicular to the rafters which provide the framework on which the *sheathing* is placed. Sheathing is the material which covers the roof boards. It is also referred to as roof decking. *Roofing* is the material that provides a watertight covering for the roof. A *roofing square* is 100 square feet of surface area. *Flashing* is any water resistant material (usually copper, galvanized steel, stainless steel, lead or aluminum) which directs the flow of water along the seams of the roof, particularly where dissimilar materials meet or where vertical surfaces interrupt the slope of a roof.





Heavy timber frame barn, showing rafter, purlins, roof boards and sheathing.

Barn Roof Framing

Your barn roof was probably constructed using one of three basic types of framing: post and beam (also called heavy timber framing), plank or balloon framing, or truss framing. Post-and-beam framing is illustrated on page 2. Heavy timber rafters rest on the top plates of the walls, and rise up to meet at the ridgepole. They are connected by horizontally placed purlins.

With the availability of dimension lumber and wire nails in the second half of the 19th century, barn roof framing gradually changed to plank or balloon framing, where the large timbers were replaced by two-inch-thick rafters spaced closer together. Roof framing with these smaller boards was much more flexible. Supports or trusses could be constructed so that the roof load was transmitted to the side walls, instead of to interior posts, thus freeing up the interior spaces for more efficient loading of hay.

In the 20th century, lightweight ready-made trusses for gambrel and round roofed barns became widely available. These were generally constructed of 2 x 4s or 2 x 6s, or in the case of round roofs, laminated 1 x 4s.

Evaluating Your Roof

A thorough evaluation of your roof structure and roofing material will tell you whether you need to repair or replace your roof. Unless a leaky roof has been left unrepaired for

Roofing Materials	Appropriate Pitch
Wood shingles	1:2 or greater
Steel roofing	1:4 or greater
Asphalt shingles	1:3 or greater

(Pitch is the vertical rise of the roof divided by the horizontal run of the roof.)

many years, roof repair usually entails replacing only the roofing material. Older barns may already have had their roofs repaired, replaced or covered one or more times. A rule of thumb to use when evaluating the condition of a roof is the three-fifths rule. If less than three-fifths of the roof can be saved, damage probably extends into the supporting frame. In this case, it is usually more efficient to remove and replace the entire roof structure.

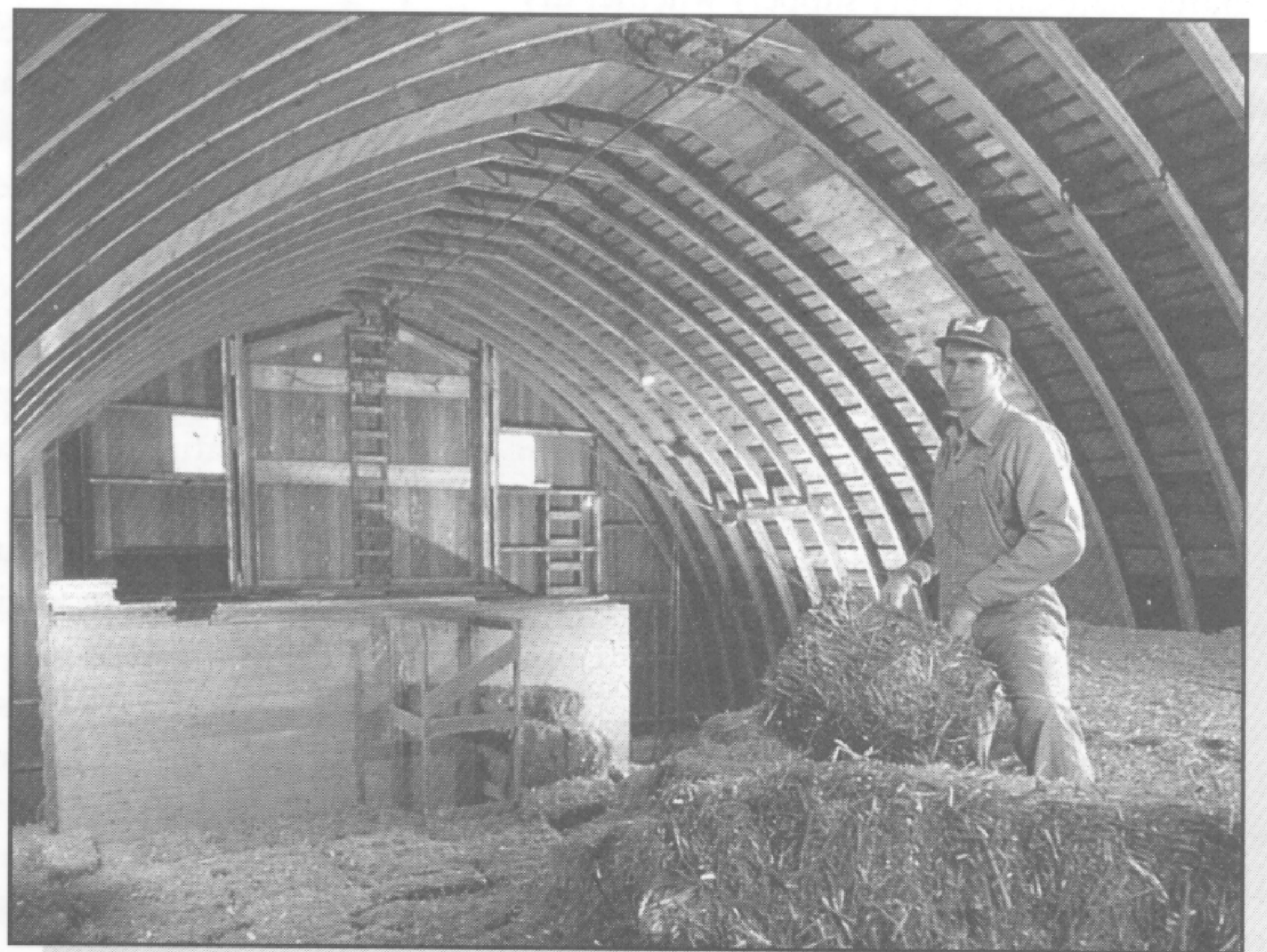
First examine the structural components of the roof: the sheathing, purlins and rafters. Damaged sheathing and rafters may need to be replaced. If the rafter is not too severely deteriorated, it may be possible to perform through-bolted, splint-like repairs. Check roof bracing and joints and repair where necessary.

Moisture is the number one threat to building materials in historic structures.

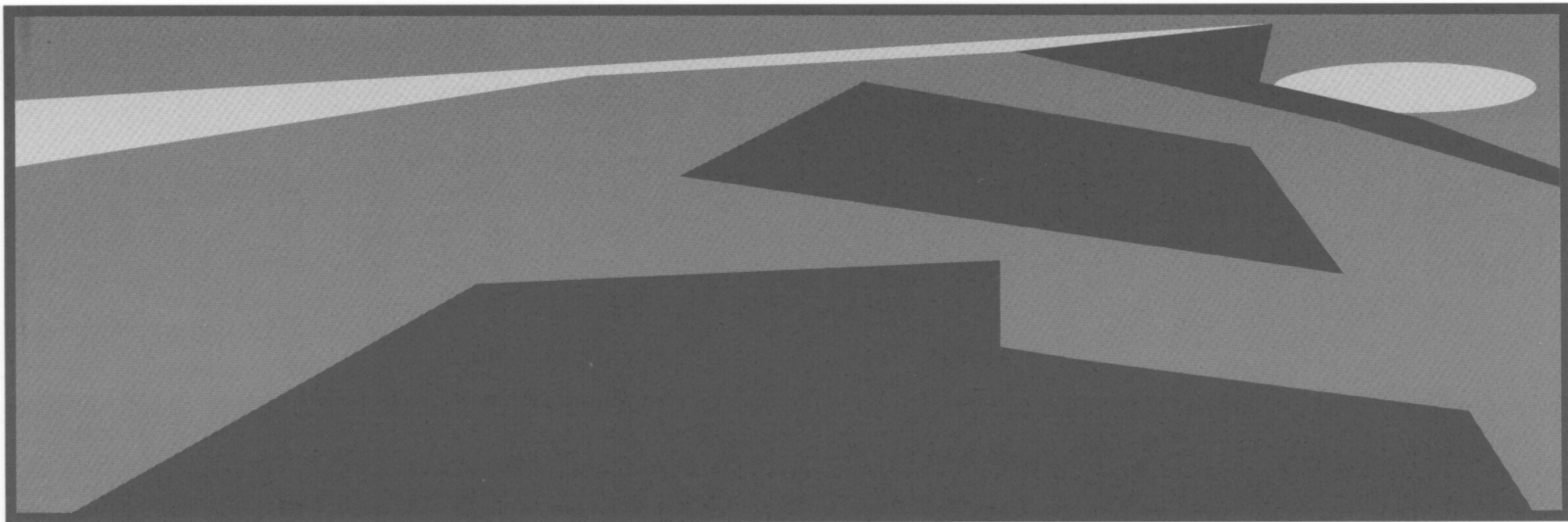
Wind loading and snow loading capacity also need to be considered. Your insurance coverage may be affected if your roof does not have the proper support. Contact your local building inspection office for recommended loadings in your area.

Next evaluate your roofing material. Inside the barn, check for roof leaks by noting drips, water stains, damaged rafters and sheathing and pinholes of light. On the outside, look for missing, torn or damaged shingles or loose sheets of metal. If the damage is not extensive, you may be able to repair the damaged section rather than replace the whole roof.

Check cupolas, dormers and other rooftop features for damage and decay, and leaking around the edges. If you discover leaks, you will need to repair or replace the flashing before repairing the rooftop feature. Usually you will be able to repair or replace damaged or missing parts of the cupola or dormer without replacing the entire structure.



Interior of round-roof barn, showing laminated 1 x 4 rafters.



Roof Repair

Each type of roofing material requires its own repair method. Following are repair tips for the most common roofing materials.

Wood Shingles or Shakes:

To remove damaged wood shingles or shakes, use a small board to elevate the butt ends of the shingles above the damaged one. Work the point of a chisel into the butt end of the defective shingle and split the shingle into slivers. Remove the old nails and slide a hacksaw blade or shingle bar under the overlapping course above. Cut the nail shanks down as far as possible. The width of the replacement shingle must be 1/2 inch less than the distance between the shingles already in place to allow for expansion and contraction. Secure the new shingle with two galvanized shingle nails driven 1/2 inch from the edge of the shingle.

Slate: Slate can be very slippery whether dry or wet, so take great care when working on slate roofs. A slate hook will make slate replacement much easier. To replace damaged slate pieces, slide the slate hook up under the damaged piece until a barb catches on the nail or nails to be cut. Tap the handle with a hammer until the barb cuts through the nail shank. A hacksaw blade can also be used to cut through the nail shank. When all the nails are cut, slide the damaged piece out. Measure the length of the old piece of slate and observe the position of the nail holes. The easiest way to cut slate is with a power saw equipped with a carborundum blade. You can also cut slate by scoring it along a straight edge with a chisel. After scoring both sides of the slate repeatedly, center the scored line over a table edge and snap the waste portion abruptly. Return to the roof to check

the fit of the new piece of slate. If the piece fits correctly, align the bottom edge of the slate with the surrounding pieces and mark the nail holes 1 1/2 inches from each edge and 1 inch down from the course above. Next, drill the nail holes with a drill bit slightly larger than the nail shank, or punch with a press. Apply roofing cement to the underside of the replacement piece and caulk under the nail heads with clear silicone which is more durable than roofing cement and less visible. Nail the new slate in place. Do not repair cracked slate by patching with roofing cement. The patch will be short-lived and unattractive.

Metal: When tackling leaks in metal roofs, start by placing a dab of silicone caulking under suspect nail heads. If leaking is widespread, examine the roofing material and how it is nailed. Metal roofs should be applied using neoprene-gasketed ring nails; non-gasketed nails admit water. Also, check for proper nail location. Nails should not be driven in the valleys of corrugated metal roofs where the water is channeled.

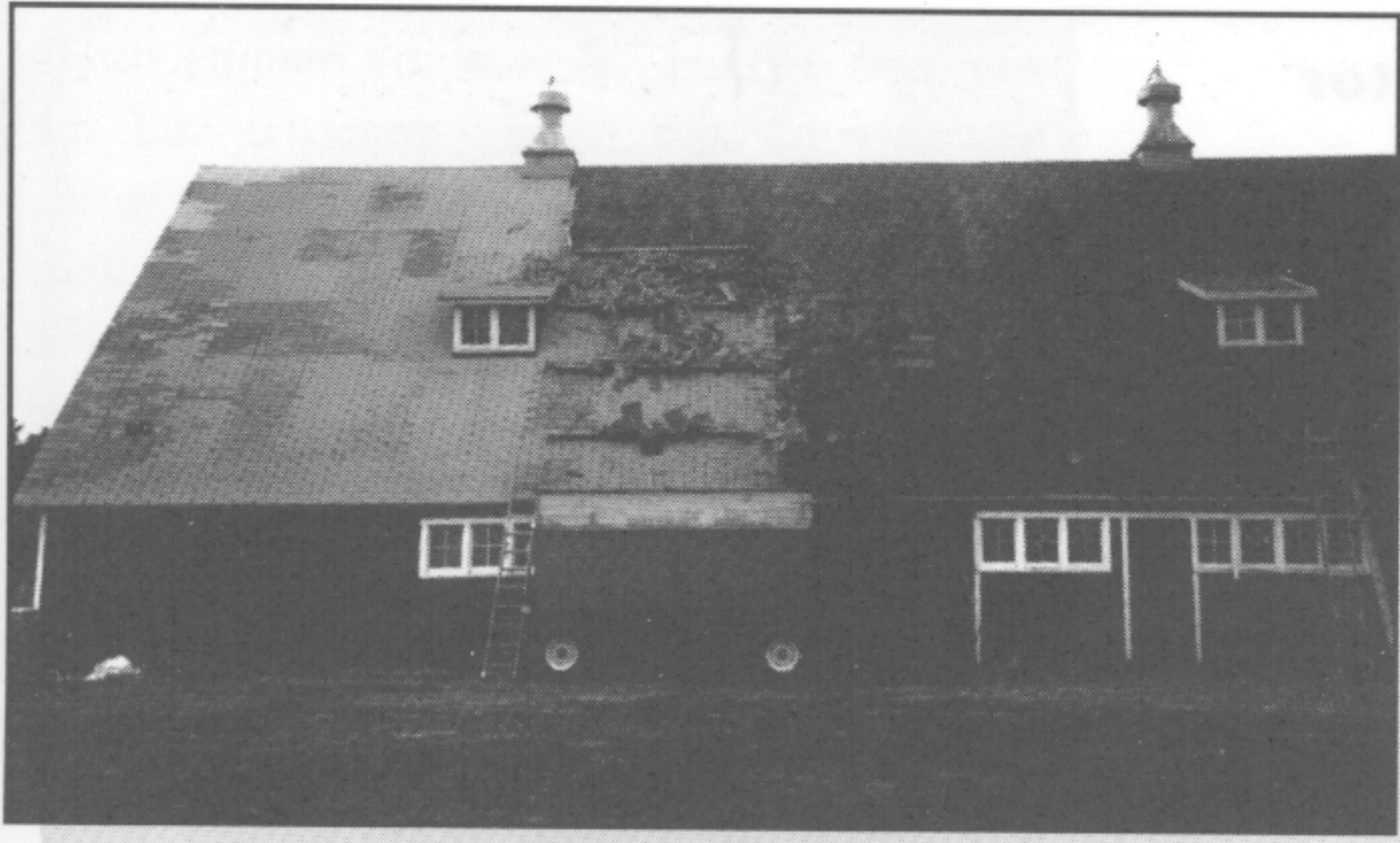
The second place to look for leaks is the joints between metal panels. You can try caulking and re-nailing the panels. Other options to consider include coating with *snow roof*, *galva-grip*, or other fiberglass-textured roof coatings (see section on paints). In addition, elastomeric coatings are excellent for filling nail holes and cracks in metal roofs. Polyester fabrics can be used to reinforce elastomeric coatings in critical areas such as valleys, roof transitions and roof penetrations and areas where the roof has deteriorated and coatings alone will not be sufficient to provide a waterproof barrier.

Asphalt: Whenever possible, replacement asphalt shingles should be identical to those already in place on the roof. Shingles badly

lifted by wind can be repaired by applying roofing cement under the loose edges and pressing them down. When a shingle has a small tear, lift the shingle and spread roofing cement under the full length of the tear. Next, put a small dab of cement under each roofing nail head, press the torn shingle down, and nail on both sides of the tear. Avoid applying cement over the tear.

To remove a damaged asphalt shingle, use a utility bar to remove the two rows of nails holding the damaged shingle (one row of nails along the middle of the shingle, and another row along the upper edge). Take care not to gouge intact shingles. Cover all old nail holes with small dabs of cement. Slide the new shingle in place, aligning its bottom edge. Start at one side of the shingle and nail across to avoid buckling. Nails should be overlapped at least 1 inch by the shingle above. Be sure to apply cement under the edges of all shingles that were lifted to reach the damaged one. If removing old nails is impossible, tear out the damaged asphalt shingle and relocate new nails.

Paints: Painting is one way to prolong the life of your roof. Paints can help prevent corrosion on metal roofs and can also be used for decorative purposes. The key to successful painting of metals involves surface preparation, priming and top coating. It is important to paint a galvanized surface before any rust appears. Zinc coated or galvanized metal roofs must first be treated with a specially developed primer in order for paint to adhere to the coating. Tractor and implement paint, enamel or lacquer, exterior enamel and exterior house paint can all be used if proper guidelines are followed. Water-base or latex paints are less resistant to moisture than oil-base paints and depend on the primer to prevent rust. However, some latex



paints are especially formulated for metal roofing and are quite satisfactory for this purpose. Paints made of zinc dust and zinc oxide provide excellent rust-prohibitive qualities, adhesion and abrasion resistance. Aluminum paints made with silicone resin give the greatest heat resistance.

Bituminous roof coatings made with asphalt and other fillers provide good weather resistance. The addition of aluminum powder adds high heat reflectance for cooler temperatures inside the structure.

A more recent and highly effective product is elastomeric roof coating. This product contains acrylic resins, pigments and other additives which are applied like paint, but when dry provide a roof coating with rubber-like properties that expands and contracts with the roof.

Wood shingle roofs may be treated with preservative stains. However, care must be taken to select a stain which will not trap moisture on the inside of the shingles causing the roof to deteriorate from the inside out. Because of moisture considerations, painting wood shingles with latex or oil-based paints is not recommended, especially for barns that are heated or used to house livestock.

Flashing and Gutters: If you discover leaks in open-valley flashing, first check to see if any nails have been driven into the flashing. To repair an obvious hole, wire-brush the hole and fill it in with fiberglass, epoxy or silicone caulking. When the filler is dry, paint the surface with a metallic paint that matches the original material. You can put a new piece of flashing over an old one if the new piece can be tucked under the overlapping piece above. Flashing leaks may also be found where vertical surfaces are flashed such

as where a dormer rises out of the roof. To repair, it is necessary to remove any siding or roofing that borders the flashing seams. Make replacement flashing from 26-gauge sheet metal 8 inches to 16 inches wide. There should be a minimum of 4 inches of flashing under the wall's siding and over the roof below. After caulking over and under the edges of the new flashing, replace roofing and siding.

Gutters require periodic maintenance. The entire gutter system should be flushed of leaves and debris with a hose. If water is standing in the gutters, it may be necessary to correct their pitch. Hanging straps should be adjusted to allow a continuous downward pitch of 1/16 inch per foot. Sagging or broken straps should be re-nailed or replaced.



Gutters should be supported with hangers every 3 feet (every 18 inches for areas with heavy snow). For every 30 to 40 feet of gutter, there should be a downspout. Small cracks or gaps inside the gutter can be repaired with asphalt roofing paint. To patch holes in metal gutters, first wire-brush the hole. Then cut a new piece of compatible material several inches larger than the flaw. Position the patch and paint with a metal primer, roofing cement or auto-body fiberglass. Where gutter seams part, secure the metal joints with self-tapping sheet-metal screws being careful that the screw points don't stick into the gutter channel. Cover the screw heads with roofing cement or silicone caulk.

Drainage: To adequately protect your barn, your roof must shed water away from the foundation. Check the drainage around the perimeter of the barn,

and regrade if necessary. Be sure that drainpipes carry water far enough away to avoid soaking the foundation.

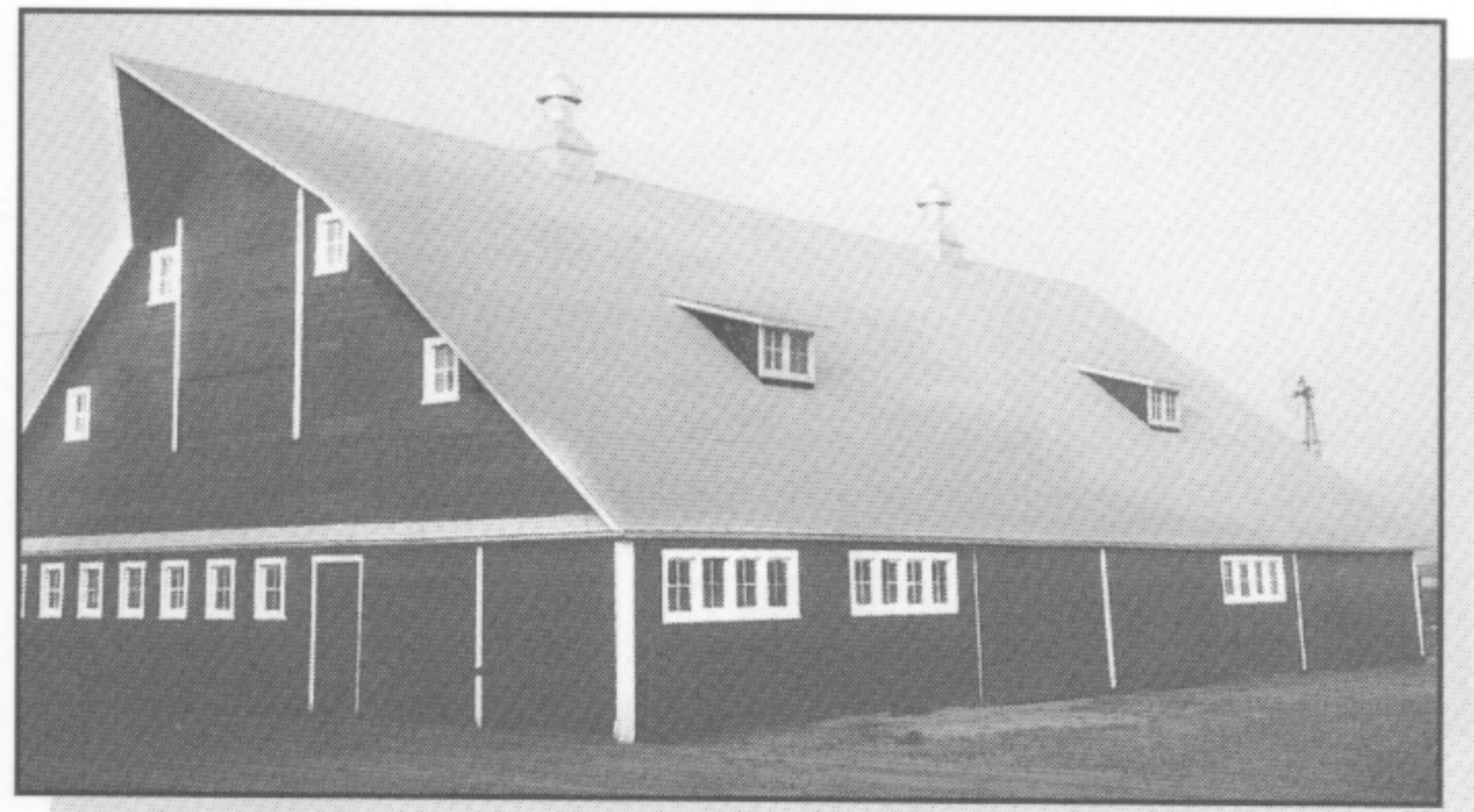
Roof Replacement

If the roofing material is badly damaged or deteriorated, the entire surface may have to be re-roofed. It is best to remove all of the old roofing before installing new material. This reduces the weight on the roof structure and allows for better attachment of the new roofing material. A flat shovel works well for this job. If you must apply new roofing over old, avoid having more than two layers under the new roofing material.

When selecting a new roofing material, consider durability (expected life of the roofing material), maintenance (amount of maintenance required), applicability (the slope of the roof may determine which type of roofing material to use) and cost. The roofing material selected should also be compatible with the other buildings on the farmstead in terms of color and texture. Carefully follow manufacturer's instructions for application of new roofing materials. You might want to consider adding a layer of *Ice and Water Shield* or *Weathergard* on eave edges and valleys and around dormers and other openings to provide added protection.

Consider historic preservation guidelines if your project will qualify for tax credits or other preservation incentives. Contact your state or local historic preservation office to get information on guidelines for replacing roofing materials as well as a list of suitable substitute materials in cases where original roofing materials are not available.

If the roof is badly damaged or deteriorated, the entire roof may have to be replaced.



This Nebraska barn got a new roof in 1998. Several layers of old roofing were stripped off and new asphalt shingles applied. Cost was \$8,984, including labor.

Roof Safety

If you decide to repair the roof yourself, there are safety precautions which should be carefully observed. Roofing can be slippery and brittle, especially when the weather is wet or conditions are below freezing. Be particularly careful when working with asphalt roofing material in hot weather. Warm asphalt can stretch and tear.

When working on the roof surface, keep the area clear of debris and avoid stepping directly on crumbling or deteriorated roofing. In addition, wear soft, rubber-soled shoes such as sneakers which provide better traction. Secure all ladders. The foot of the ladder should be one-quarter of its height away from the barn that it is leaning against. Overlap extension ladder segments by at least one-quarter of the section's length. Don't work on the roof alone; use the buddy system. Make sure that someone is on the ground watching you and steadying the ladder when needed. When working on steep roofs, use a roofing ladder that has a safety bracket hooked over the roof's ridge. Use a roof jack or rack to hold tools and roofing supplies while you are working on the roof. Roof jacks or racks can be nailed directly into the rafters and applied in courses along the roof. Planks are then laid across the jacks allowing for a 1-foot overhang over the jacks. To prevent serious injuries, always use fall protection (safety belt or harness secured to a solid support) when working on a roof.

Hiring a Contractor

You can save money by doing all or some of your roofing project yourself. How much you decide to do will be determined by your time constraints and the difficulty of the project, as well as your own expertise.

If you decide to hire a contractor, first prepare a list of tasks. Be sure to include all necessary tasks, such as removing old roofing, structural repairs, repairing flashing and gutters and removing debris, as well as applying the new roof. Get at least three bids before selecting a contractor, and make sure that all bidders are proposing the same work.

Check references and credentials before hiring a contractor. Look at finished jobs which are more than a year old. Check insurance (liability and workers' compensation). Insist on seeing samples of proposed roofing materials. Be sure to note the type, color, weight, manufacturer and guaranteed longevity of the roofing material

you have selected. Review the manufacturer's warranty for the roofing material and the contractor's warranty for his work. Determine if any local licenses are required. Agree upon a completion date and payment plan. All of this information should be clearly stated in your contract.

If your project is complex, you may want to consider hiring an architect or professional consultant to prepare a design and specifications for bidding. Although this adds to the expense of the project, it can help you avoid misunderstandings about what was supposed to be included in the contractor's bid.

The cost of repairing or replacing a roof can vary greatly.

Average Roofing Installation Costs (Cost of Materials plus Labor)

The cost of repairing or replacing a roof can vary greatly, depending on the type of roofing material used and the size of the roof. Following are some average costs for various types of roofing materials. Other project costs might include: repair or replacement of the roof structure, cost of safety equipment and disposal fees.

Material

Costs

Wood shakes installed with felt and nails	\$400/\$450 per roofing square
Asphalt or Fiberglass shingles (25 year)	\$90/\$100 per roofing square
Asphalt or fiberglass shingles (30 year)	\$100/\$110 per roofing square
Metal- standing seam (Primed, painted felt, nails, clips)	\$320/\$340 per roofing square
Metal-channel drain	\$190/\$200 per roofing square
Metal-corrugated	\$155/\$170 per roofing square
Slate (felt and nails)	\$825/\$995 per roofing square
Tile (prices vary according to type)	\$1150/\$1350 per roofing square
Gutter installation 5"/6" (half round gutters with conductor)	\$4.65/\$5.10 per running foot
Tear off old roofing	\$45/\$46 per square

Safety Procedures for Working on Roofs

1. Don't get on roofs in wet or freezing weather
2. Don't get on asphalt roofs in warm weather
3. Keep roof free of debris
4. Wear soft rubber-soled shoes for traction
5. Secure all ladders
6. Use the buddy system
7. On steep roofs, use a roofing ladder
8. Use a roof jack or rack
9. Always use fall protection

Tips for Hiring a Roofer

1. Prepare a list of things to be done
2. Get at least three bids
3. Check references, credentials and previous work
4. Check for liability and Workers Compensation insurance
5. Agree on completion date and payment plan

Roof Maintenance

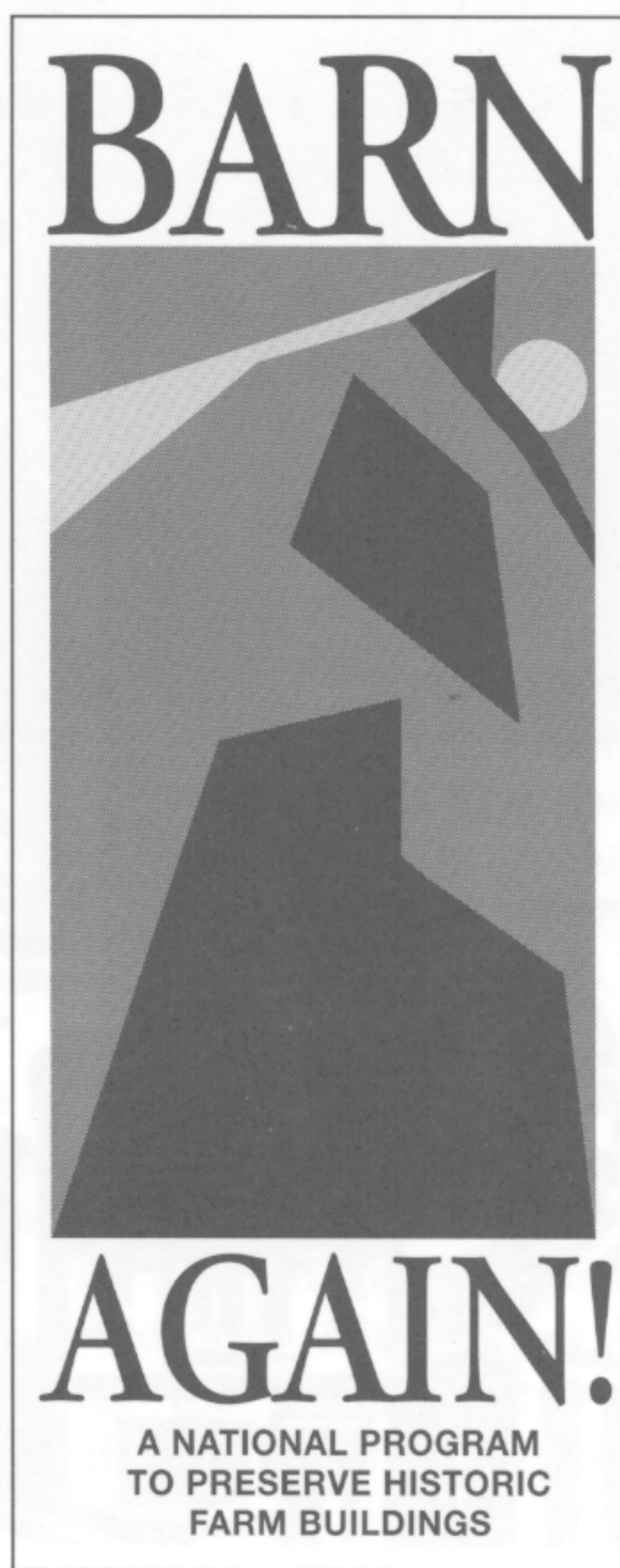
Once the roof has been repaired, it is important to maintain its condition. Perform an annual inspection on the roof, both inside and outside, to detect signs of damage or decay. If necessary, use binoculars. Be sure to inspect roofing overlaps, intersecting walls, flashing, ridges, eaves, valleys, around cupolas, ventilators and dormers and places where snow and ice fall onto the roof. On the outside, look for bulges, separations, cracks, loose materials, and bare areas. On the inside, look for drips, dark water stains, and pinholes of light showing through the roof. Clean out gutters and downspouts, and make sure that water is directed away from the barn and its foundation.

*Once the roof has been repaired,
it is important to maintain
that condition.*

As part of a routine maintenance program, inspect the flashing and repair any damage immediately. Spot repairs to roofing material may need to be done as described previously, depending upon the type of roofing material used. Do not use tar to temporarily repair leaks.

Historic Preservation

If you are planning to restore your barn, check with your state historic preservation office for help in formulating rehabilitation plans and in locating experienced professionals to help with the project. You may also qualify for a federal tax credit of 20% of the cost of rehabilitating your historic barn, or 10% of the cost of rehabilitating non-historic barns built before 1936. In addition, some states have additional tax incentives available to barn owners.



For More Information

Organizations and agencies:

State Historic Preservation Office (SHPO)

Advice on maintaining the historic character of your barn and information on the National Register of Historic Places and rehabilitation tax credits. Some SHPOs also maintain a list of rehabilitation craftsmen and architects. Contact the state government directory for your state.

Cooperative Extension Service

Assistance with specific building projects and plans. Contact the Administrator, Federal Extension Service, Washington DC, the Extension Service Director at the land grant university in your state, or your county Extension agent.

BARN AGAIN! Program

General advice and assistance with barn rehabilitation projects. Contact the National Trust for Historic Preservation (303) 623-1504. Or visit the BARN AGAIN! Website at www.barnagain.org.

Publications:

Litchfield, Michael W., *Renovation: A Complete Guide*, John Wiley & Sons, Inc., NY, 1982 ISBN: 0-471-04903-4

National Park Service, *Preservation Brief #4, Roofing for Historic Buildings; Preservation Brief #19, The Repair and Replacement of Historic Wooden Shingle Roofs; Preservation Brief #29, The Repair, Replacement and Maintenance of Historic Slate Roofs; Preservation Brief #30, The Preservation and Repair of Historic Clay Tile Roofs*. Superintendent of Documents, PO Box 371954, Pittsburgh, PA 15250.

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