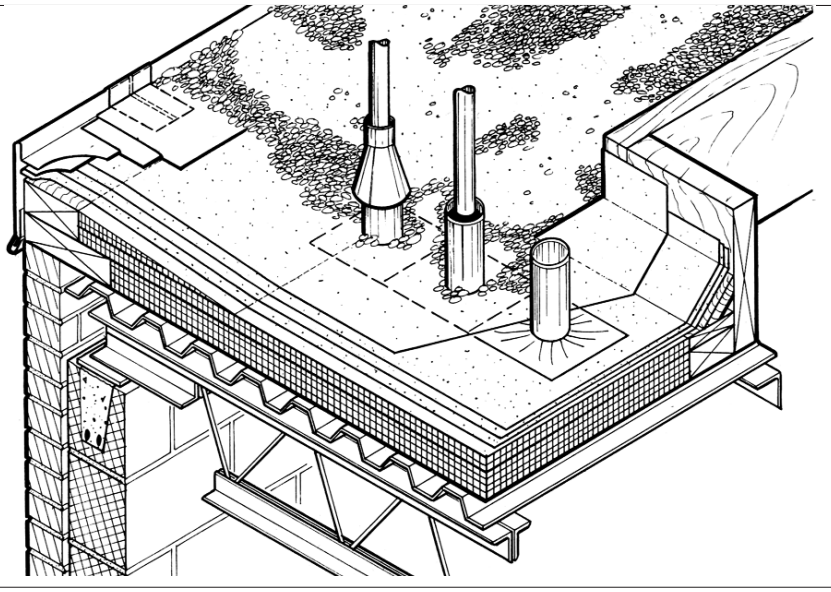
FLAT ROOF REPAIR GUIDE

by Brad Raleigh



It takes detective work to locate leaks and a thorough knowledge of membranes to patch them

Most general contractors don't have the experience or the tools to diagnose and repair flat roof problems. In most cases, it's best to sub the work out to a local roofing specialist. But it's helpful to have enough knowledge on the subject to converse with the roofer or to advise the owners on the best course of action. Plenty of good roofs are ruined by misguided repair efforts or by incompetent tradesmen who cut a lot of holes and smear on a lot of goop without understanding the system they're working on.

There are many different types of flat roof membranes (see "Roof Sleuthing"). But the majority of residential flat roofs are covered with built-up roofing (BUR) made by overlapping layers of asphalt-impregnated felts and fusing them together with hot asphalt or cold mastic. BUR dominated the flat-roof market until the 1980s, when single-ply membranes became popular.

There are dozens of different types of single plies. The most common are rubber roofing, typically EPDM or Hypalon, and plastic, often made from PVC with plasticizers added for elasticity.

According to the Single-Ply Roofing Institute, the number of small commercial and residential roofs with single-ply membranes will increase dramatically over the next decade. Single-plies are generally quicker to apply and easier to maintain. Also the single-ply industry has matured. The companies that have survived seem committed to providing reliable products and good service.

Some residential flat roofs use inexpensive roll roofing. Referred to as "90-pound," the granular-surfaced material is made from heavy, double-coated organic or fiberglass felt. One 36-inch roll weighs about 90 pounds.

Life expectancy for different membranes ranges from 15 to 20 years for BUR, modified bitumen, and rubber roofing, to about ten years for plastic membranes and roll roofing. But this varies depending on the weather the roof is exposed to, the installation, and how well the roof is maintained.

Detecting Leaks

Finding leaks without cutting lots of test holes requires some good detective work since the water damage inside the building does not always correspond with the location of the roof leak. That means relying on what you can see and feel, as well as on past experience.

First, consider how the roof and its infrastructure are designed. If the membrane is supported by a metal deck, water is likely to run along the ribs before finding its way down to the ceiling. If there's a suspended ceiling, the water may follow the metal tracks before it becomes visible. Wood plank decking usually shows leaks close to their source. Plywood, however, allows the water to travel further before it drips down, saturating the insulation and the drywall below.

Take note of when leaks occur. Some will show only when the wind is blowing rain from a certain direction, indicating the problem is with a flashing that's exposed to that wind. If leaks show every time it rains, the problem is probably on the open field of the roof. A roof that leaks only after snow melts often means water is damming due to drainage problems.

Sometimes you can get behind the ceiling to find where the water is actually entering through the deck. But more often you'll have to rely on an examination of the roof itself. If there are no visible signs of leakage, you may have to cut some test holes. Remember, whatever you cut has to be patched, so cut sparingly.

Using a knife, slice a hole about 4 inches square through the membrane. If water squirts out, you've found what you're looking for. Otherwise, feel the insulation for dampness. If it's wet, you'll have to keep cutting until you find the perimeter of the affected area.

Wooden decks may be delaminated or rotted, indicating a water problem. If the deck is still intact, you may have to cut through it to get a look at the insulation. As a general rule, if one-third or more of the insulation is wet, it's more economical to tear the roof off than to repair it. In any case, wet insulation should be replaced.

Patching Procedures

Patching techniques vary according to the membrane and the size of the area to be covered. The first rule is to patch with compatible materials. Using bituminous products on an

Roof Sleuthing

Figuring out what type of roof you're working on may take some detective work. Here's a quick guide to identifying different roof types. In some cases, you may have to call on a local roofer for assistance. Manufacturers and roofing trade associations may also help.

BUR. Built-up roofing is often coated with some type of aggregate, usually pea gravel, that's set in a flood coat of hot asphalt. On smooth-coated varieties, you'll see the ply seams at regular intervals, every 8 inches or so. When the roof is coated with aggregate, you may have to clear a section to look for the plies. If a mineral-surface cap sheet is applied, it may be hard to tell BUR from modified bitumen.

Some BUR is made with coal tar, a bituminous product that comes from the coking of coal. It is normally found on roofs in steel producing areas, like Buffalo, Cleveland, Pittsburgh, and Detroit. Coal tar BUR is not compatible with asphaltic BUR. Test for it by dropping a small sample into a container of mineral spirits. Coal tar, which smells like creosote, will not dissolve, while petroleum-based asphalt will.

Modified bitumen. This is a one-ply membrane made of asphalt or coal tar blended with polymers. It may have a smooth, metallic, or granular surface. At cooler temperatures, some types of modified bitumen are glassy or brittle. On smooth surfaces, you'll see 3-inch or 4-inch laps at approximately 36-inch intervals. Also look for melted bitumen that may have oozed from the seams during application.

EPDM. Ethylene propylene diene monomer is a synthetic rubber. This type of single-ply resembles a dusty inner tube. Like all single-plies, it may be ballasted (attached to the roof with large chunks of aggregate), differentiating it from BUR or modified bitumen. A small sample from a test cut will stretch easily and snap back when released. The material also comes in larger sheets than plastic roofing.

Hypalon. This is a trade name for chlorosulfonated polyethylene (CSPE). Although it looks black from exposure to pollution and dirt, if you clean Hypalon with a damp, soapy rag, you may find it is a different color, often white, gray, or blue. Also, since Hypalon is a rubber roof, it has characteristics similar to EPDM.

PVC. Like Hypalon, polyvinyl chloride, when it is cleaned, is often a different color. But a small test sample may crack when you try to bend it.

— *B.R.*

Figure 1. *For clearing aggregate from a large area, most roofers use a spud bar.*

Figure 3. *The majority of roof leaks occur at flashings. The flashings where flat roofs intersect steep roofs or walls should rise at least 8 inches above the plane of the flat roof.*

EPDM roof, for instance, will cause the EPDM to swell and bubble. Also some plastic cements contain solvents that will dissolve bitumen products. When working with single-plies, it's best to check the manufacturer's recommendations.

If you have to make emergency repairs and aren't sure what type of roof you're working with, don't patch with anything you can't remove later. I recommend duct tape or, if the area is large, heavy plastic held down with tape. Once things have calmed down, you'll have a chance to get back on the roof and make the repairs properly.

It's easier to find leaks and make patches on roofs with smooth rather than aggregate coatings. Clearing away aggregate is a real nuisance, but it must be done before patching. To make the job easier, try working in the early morning when the roof is cool. Use the claw of a hammer if the area is small. For larger areas, roofers use spud bars or chipping bars, long metal rods with a blade at the end (see Figure 1). Smaller stones can be scrubbed away with a wire brush. Always be careful not to damage the membrane.

At least two layers of felt or glass fiber mesh should be used to repair BUR. The bottom layer should be 1 1/2 inches smaller around the edges than the top layer so that each will bond separately to the existing membrane (see Figure 2). Apply the patch with a thin coat of plastic roofing cement. Hot mopping or cold mastics get messy and I've found that roofing cement is just as durable.

Modified bitumen is another useful repair material. A single layer of the material will repair modified bitumen roofs, as well as BUR and roll roofing. For small patches, lay the material on a sheet of plywood and heat it with a propane torch. Then apply the patch over the hole, being careful not to wrinkle it.

For larger patches, place the sheet of modified bitumen over the hole and fold it in half. Using the torch, heat the exposed half and fold it over the hole. Then do the same on the other side. If the patch is not holding properly, heat your trowel and slide it under the patch to lift it. Then reapply the torch and smooth the material down. Do not heat the patch from the top as this will damage the membrane. Also, take safety precautions with the open flame.

Flashings First

The majority of roof leaks come from problems with flashings, particularly the metal edge flashings used to terminate the roof system and prevent wind uplift. These strips of metal, usually 8 to 10 feet long, are nailed and cemented to the edge of the roof after the membrane is installed. They are then sealed with strips of felt called stripping plies. The metal often has a lip that prevents aggregate from washing over the edges of the roof. This type of flashing is used with BUR, roll roofing, modified bitumen and, somewhat differently, with rubber and plastic roofs. Problems will often result in water leakage showing up along exterior walls.

Trouble starts at the line where the metal is attached to the membrane. As the metal expands and contracts it pulls the roofing along, resulting in tears that must be patched. The metal lip and the buildup of stripping plies further aggravate the situation by damming water that is intended to drain over the side.

The flashings located where a flat roof connects to a steep roof or to a wall can also cause problems (see Figure 3). These flashings should rise at least 8 inches above the plane of the flat roof. But since the roof shingles or the siding are often difficult to remove, many contractors fail to place the flashings high enough.

In some cases, enough shingles have been removed but the contractor has replaced them to cover the flashings. Although it may seem unsightly to some, the vertical leg of the flashings should remain exposed at least 8 inches to allow water plenty of room to flow off the roof. The shingles that do hang over the edge of the flashing should be held down with only a dab of adhesive to prevent wind uplift. Thoroughly coating the edge of the shingles will trap any water that enters.

When the roof butts against wood, vinyl, or aluminum siding, the flashing should run underneath the siding so the siding forms a counterflashing. Metal counterflashing is required where a flat roof meets a brick or stucco wall.

Flashings around chimneys, vents, and drains should also extend 8 inches above the roof. In each case, counterflashing or some other method of sealing the top is needed.

On the Open Field

While leaks on the open field of the roof are less common than flashing problems, they do occur, often along seams.

Ponds. There's actually no such thing as a "flat" roof — a more accurate term is "low-slope." All roofs should have some slope, at least 1/4 inch per foot, for drainage. Even so, they shed water slowly compared to steep roofs. When water stops flowing altogether, it forms ponds, which are most detrimental to roofing systems.

Deflections in the deck caused by live loads (such as rain, snow, and wind) or dead loads (any permanent weight, including mechanical equipment and the roof system itself), cause ponded water. Once ponds form, they add to the live load, furthering deflection. They may freeze and thaw, eroding the surface and causing leaks. Ponded water can also create roof swamps, entire ecosystems that include algae, grass, and an occasional duck or seagull.

Roofs with extensive ponding must be replaced. If there are only small, isolated puddles, you may be able to build up the roof in those areas with a thin layer of insulation and cover it with a roof patch.

Blisters. Blisters are smooth bumps on the membrane that are filled with air or water. No one is certain what causes blisters, although many theorize that moisture trapped beneath or between the plies when the roof was applied vaporizes in the hot sun, expanding the surrounding membrane.

Blisters themselves are not a problem, except that they tend to get bigger and are therefore more likely to create a leak if they fracture. For that reason, it's important to ban foot traffic on roofs with blisters. It's also best not to tamper with them until they break.

Some roofers swear by blister vents, devices that allow the gases within the blister to escape so the swollen membrane collapses back onto the roof (see Figure 4, page 34). The vents, which resemble 1-inch hex bolts with a 3/4-inch shaft, are screwed into the blister and remain until the roof is patched or replaced. I don't use them since it's just as easy to patch a broken blister as it is to screw in a vent. Also, since many blisters form between plies, breaking them won't result in leaks anyway.

To repair a broken blister, cut out the entire blister and allow the exposed area to dry. Patch the area with a compatible material.

Ridges and splits. Ridges are long, narrow wrinkles that frequently occur over joints in the roof deck. Sometimes they indicate that warm air from the building below is escaping through the joints and causing the membrane to expand. They may also indicate poor attachment of the membrane or problems with the deck itself.

Some wrinkling is inevitable when the membrane is applied. But significant ridges are prone to weathering and may interfere with drainage. It's best to have a roofer pull them flat or lay ballast over them for protection.

Splits are also found over the joints, although they can occur anywhere the membrane is stressed. If the membrane is attached to the deck improperly, it may pull and tear as the deck moves. Ragged splits often occur along the perimeter of a ponded area or where the membrane is stressed by excess loading. Patches applied over splits are often unsuccessful if the stress on the membrane

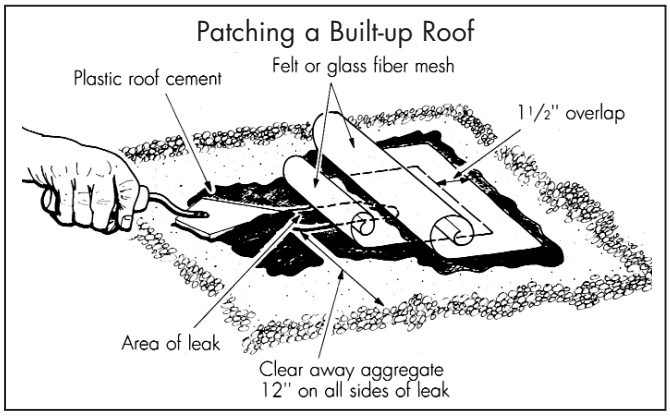


Figure 2: *Use two layers of material to patch a built-up roof. The top layer should overlap the bottom layer by 1 1/2 inches on all sides, allowing each layer to adhere separately to the membrane.*

comes from forces beneath it.

Alligatoring. Most membranes are more resistant to weathering if they receive a protective coating. BUR usually has a layer of aggregate over it while other membranes rely on liquid coatings, such as an asphalt-solvent-based aluminum coating, for protection and added strength.

Unless it is protected, an aging roof will start cracking, or "alligatoring." These small, irregular fissures grow as dirt and water become trapped inside them. Eventually leaks may result.

The best way to avoid alligatoring is to keep the roof coated. The material you select must be compatible with the roof type and should be applied once every five years or so, depending on weather conditions. Eroded aggregate should be replaced by spreading a layer of asphaltic roof coating or plastic roof cement and spreading new aggregate.

Fishmouths. Found on both single plies and BUR, these gaps occur at seams and are usually caused by installation problems (Figure 5). On BUR, "fishmouths" are formed by stretching the felt during installation or by using felt with damp edges. On single-plies, fishmouths are the result of excess solvent (PVC systems), contact cement that is not allowed to dry (rubber systems), or inadequate heat-welding (PVC or modified bitumen systems).

Fishmouths are repaired by slicing the gap down the middle until you get to where the membrane is properly adhered. The resulting flaps should be trimmed and fastened to the roof with plastic roofing cement or an adhesive compatible with the membrane. Any exposed areas should be patched.

Inspection and Maintenance

Because of a lack of basic maintenance, many roofs are replaced long before their projected life is up. It's best to find problems before damage is widespread. That makes repairs easier and less expensive.

Building owners should be urged to keep good records about their roofs, including what kind of membrane is used and what types of repairs are made. Like steep roofs, flat roofs should be inspected twice a year for loose flashings, clogged gutters, and other problems. The worst time to look for leaks is during foul weather, when problems are hard to spot and water is pouring down the interior walls. ■

Figure 4. *Blister vents allow the gases within the blister to escape so the swollen membrane collapses back onto the roof.*

Figure 5. *Fishmouths are found at seams and are usually due to installation problems.*

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