



THE GLASS HOUSE FLAT ROOF REPLACEMENT

This document helps address the challenges and opportunities the modern flat-roof homeowner faces in deciding whether to repair or replace their roof. Flat roof varieties, installation methods, and maintenance recommendations are also presented. An overview of the replacement of the Glass House roof helps to alleviate the anxiety a homeowner might have in understanding the process of making the best preservation decisions.

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I. The Flat Roof: An Overview

With the advent of new technologies and structural systems in the early twentieth century, house design was able to reach a new level of aesthetic expression never previously realized. Pure geometry was now able to be represented without being overshadowed by applied ornament. This was a great departure from precedents decorated with historical references.

The flat roof boldly represents the new freedoms and departure from historical “references” found in this new modern architecture. A majority, but not all modern houses have flat or very gently pitched roofs to achieve the tenets of modernism. Regional interpretations vary.

This resulting change in architecture leaves the modern homeowner with the daunting task of how to maintain, repair and replace their flat roof. These tasks do not have to be so daunting. This module will help the homeowner identify their roof; understand preventive maintenance; and know how to pursue repairs and replacement with confidence.

The Glass House roof replacement of 2007 is explained and illustrated in order to emphasize that the process is quite achievable.

II. The Glass House Roof

The Glass House roof was replaced, during the winter of 2007. The assumption was that the existing roof was the original constructed in 1949. As planning began for preparing the property for public visitation, an expert roof consultant was hired to investigate and assess the longevity of each buildings roof system. Investigative probes (cutting through the layers of roofing material) identified two roof systems, with water trapped between the layers, giving evidence that a second roof was installed over the first. This information coupled with evidence that flashings and attachment points were wearing out precipitated the design of a full roof replacement.

Because the Glass House has a dead flat roof with only one drain, it was decided to replace the roof with a Coal Tar Pitch Built up Roof with stone aggregate surfacing matching that of the original roof. While seldom used because of the unpleasant caustic application, coal tar pitch was chosen because it was the most fail-safe choice for the existing conditions; it will accept ponded water and its finished appearance matched that which Philip Johnson had ultimately chosen to be visible.

The roof replacement included the full removal of both existing roofs, repair of roof sheathing, resetting of the drain, and replacement in kind of steel fascia assembly parts and flashings. In order to achieve many of these repairs disassembly of the fascia, the roof lights and the chimney had to occur. The individual components had reached their life expectancy, and therefore required replacement.

III. Roof Types

- **Multiple-Ply or Built Up Roofing (BUR):** Traditionally, flat roofs have been installed by setting 3-4 layers of asphalt-saturated felt (“tar-paper”) in a mopping of hot asphalt. Typically, the surfacing is gravel set in a flood-coat of hot asphalt. This is generally referred to as “conventional built-up roofing (BUR)”.
- **Single-Ply Membranes:** Over the past 30 years, a wide variety of roofing membranes have been developed, using various forms of synthetic rubber and vinyl. The membrane is manufactured under controlled conditions in the factory. The seams are typically formed on site, using adhesives, tapes, or hot-air welding. Some are available in different colors, and can be manufactured in wide rolls to minimized the number of seams.
- **Modified Bitumen:** These membranes are still asphalt-based materials, but plasticizers have been added to improve strength, flexibility, water-resistance, etc. They can be incorporated into a conventional BUR, or applied as a single-ply membrane.
- **Seamed Metal:** Traditionally, small flat roofs were installed using flat-locked tin or copper, with the seams fully-soldered. This is very labor-intensive, and is not used on large areas. There are also standing-seams metal panels that can be used on very low-pitched roofs.
- **Liquid or Spray-Applied:** A wide variety of liquid systems are available that can be applied with roller, squeegee, or spray. Some incorporate a reinforcing fabric bedded in the liquid. These systems are sometimes used as a coating over an existing roof.
- **Green Roofs:** There is a growing interest in roofs that are more environmentally friendly. These include roofs that are overlaid with plantings to provide a “garden roof”, as well as roofs that incorporate sustainable materials, reflective coatings, and efficient insulation.

IV. Application Methods

- **Adhesive applied (hot or cold):** The convention BUR roofs were attached in hot asphalt. The same technique can be used for the modified bitumens. But cold adhesives have become very common, to avoid the need for a kettle to heat the asphalt. Many of the single-ply systems use contact adhesives to attach the membrane.
- **Torch Applied:** The most commonly used form of modified bitumen is applied with a torch. The membrane is heated with a large open flame which melts the underside of the membrane and causes it to stick to the substrate. Similarly, the seams are heated with a torch to fuse the layers together where they overlap (usually about 3” wide).
- **Liquid Applied:** The liquid and spray systems are applied like coatings, and require a suitably prepared surface for proper adhesion.
- **Mechanically Applied:** Some of the single-ply systems are secured with rows of screws and plates (large washers). These fasteners are usually incorporated in the overlap, so they are not exposed.

V. Roof Maintenance

Maintaining a flat roof is of critical importance. Most flat roof installations will last for a very long time if proper maintenance takes place a minimum of twice a year, and optimally, on as need arises. Regular maintenance for any flat roof would include removing loose and embedded debris, sticks and moss, clearing drains and inspecting seams, connection points, flashings and penetrations for wear and tear. Trimming back tree limbs and removing deadwood from adjacent trees should also take place. The Glass House roof is inspected regularly after wind storms and freeze thaw cycles. Drains are maintained and the accumulated fine debris is blown off during the period of time that the adjacent trees drop seed pods in the spring and leaves during Autumn. The trees surrounding the Glass house are crown cleaned once every few years.

It should be understood that this maintenance should not lead one to believe that a flat roof is more labor intensive than the care of other roof systems. It is not. All roofs, gutters and downspouts require regular maintenance.

VI. Roof Replacement / Restoration Options

Roof replacement often does not have to be the only solution. A competent roofing consultant, architect or contractor will assess the roof assembly for errors, aging, deterioration and damage. Flat roof systems, when properly maintained can usually be repaired. Replacement should usually only occur if the product has reached its life expectancy, or if it had been installed incorrectly.

VII. Challenges

The challenge in deciding to restore, repair or replace a roof is generally in choosing the appropriate consultant or roofing company, and feeling confident that the repair and replacement products recommended are the most effective.

To select the most qualified consultant or contractor, a homeowner should first try to identify who may have installed and maintained the roof originally. If the roof has performed well over time then the original installer or their predecessor will want new work to perform well and live up to previous expectations. The homeowner can also request names from preservation organizations such as: Modern homeowner organizations; www.arapahoeacres.com, www.hollinhills.org, and www.eichlernetwork.com or State Historic Preservation Offices; www.cr.nps.gov/nr/shpolist.htm, and they can check with the Better Business Bureau; www.bbb.org, or a local consumer protection agency.

The second challenge may be philosophical. New technologies, and products may be offered that will challenge the preservation of your structure. You will have to weigh the options that are presented against desired effect. You may have to make a compromise. Code requirements may also challenge preservation. In warm weather climates, energy codes may require roof systems that will reflect the sun and reduce cooling demands. This could result in bright, light reflective systems which alter the visual appearance. In cold weather climates, energy codes may require the addition of insulation layers which will affect the roof profile and could compromise ventilation and cause condensation problems. Compromise is fine if it is well thought out and respects the original design intent, especially if it ensures that your house will live on for the next generation.

VIII. Opportunities

- Increase in drainage
- Increased insulation
- Better reflectivity which will decrease summer air conditioning
- Correction of original mistakes

IX. Recommendations For Your Meeting

- Access the roof with any consultant or contractor who visits the site: this helps ensure that it is understood that the work will be critiqued.
- Watch and listen to the consultant or contractor. If they simply measure your roof and make a simple sketch and say they will get back to you they probably are only interested in replacing the roof with a standard product that they like to sell.
- Note the consultant or contractor's attention to detail. The good consultant or contractor will, thoroughly examine every part of the roof, its seams, flashings, attachment points, and connections. They will also ask if it is visible from beneath. They may also examine the roof with a Thermographic camera to look for water or evidence of failed insulation. Lastly, a good consultant or contractor may recommend doing an investigative probe to see how the roof was constructed over time.

X. Preservation

There are five key actions that the homeowner should exercise to ensure that preservation plays a role in their roof repair or replacement:

1. Study the building and its contemporaries to form an understanding of the design intent. Incorporate the elements that help define the intent in the new design.
2. Require that disassembly take place rather than demolition of key elements such as original lighting, skylights etc. Disassembly helps ensure that non-replaceable parts are not ruined or thrown away.
3. Require that samples of the roof assembly parts be saved. They should be labeled, and set aside with notes that describe where they came from. Samples may be useful for matching new parts and materials and later can be used by future homeowners undertaking future preservation work.
4. Document the original existing conditions, both the failure points and the details that were successful. Document the disassembly and any details of construction that are revealed when the roof is removed. Documentation can include photographs, drawings, notes and sketches. Always include a reference point and dimensions as well as date and year.
5. Ensure fire protection and prevention. Fire is a real threat during all construction projects, but especially roof and paint projects. When planning any project insist that the National Fire Protective Association (NFPA) publication 241 be used for establishing project safety guidelines. Establish and enforce no open flame rules, a fire watch person, end of day job site inspection, proper storage and disposal containers and placement of operating fire extinguishers.

XI. Sources / Links

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