Roofing Materials for Sloped Roofs

In recent years, residential roofs made of metal and tiles have become quite popular, both for their aesthetics and their durability. But despite their new-found popularity, these are not "new" roofing materials. The use of concrete tiles as roofing material dates back more than 150 years, and metal roofs have been in use for centuries. This fact sheet discusses the benefits and drawbacks of the most widely used roofing materials in the residential market (asphalt shingles, metal roofing, clay and concrete tiles).

Green Building Benefits

The selection of roofing materials has significant energy and durability implications. Cool roofs, can reduce roof temperature by as much as 100°F during the summer, and thereby reduce the building's energy requirements for air conditioning. The basic concept of a cool roof is to make the roof out of a material that reflects energy and emits heat. When selecting a roof, look for high solar reflectance, endurance of high reflectance over time, and high emittance.

The durability of roofing materials varies dramatically. The expected useful life can range from 10 years to the life of the building. This has direct economic consequences for the building owner and broader resource implications for society. In the U.S. alone, between 9 and 10 million tons of asphalt roofing waste is sent to landfills annually. A longer-lasting roof reduces the amount of waste sent to the landfill and makes better use of its embodied energy.

Asphalt (Composition) Shingles

Composition shingles are used on the majority of homes in the United States (account for as much as 80 percent of the residential market). These shingles are made of a base (organic or fiberglass) that is saturated with asphalt and coated with minerals on one side to resist weathering. The fiberglass shingles are more flexible and stronger than organic shingles. Shingles come in a wide variety of colors. Composition roofs can be overlaid with a new roof, if the initial roof is a single layer and in good condition. The life expectancy of composition shingles depends on the rating (quality) and ranges from 10 to 30 years. The most common problems and maintenance issues occur when the roof installation did not include adequate venting and/or flashing. Moss buildup also needs to be controlled to prevent damage to the shingles.

Dimensional shingles are very similar to composition shingles, but are thicker, and can be used to create a more custom appearance. Depending on the rating, dimensional shingles have a life expectancy of up to 40 years. The issues and concerns with a dimensional roof are the same as those associated with composition shingles, moss buildup, quality, and adequate venting/flashing.

Asphalt shingles are at the low end of the price scale. Good-quality asphalt products backed by 20- to 30-year warranties are available for $25 to $30 per square (100 square feet). Architectural shingles run to about $60 per square and come with 30- to 40-year warranties. Asphalt shingle roofs can cost anywhere from $50 to $150 or more per square installed. Tearing off the existing shingles, which is highly recommended, will add another $30 to $50 per square.

Metal Roofing

Metal roofs are great for any type of roof and are ideal in forested, moss prone, or heavy precipitation areas. Typically manufactured from steel, aluminum or copper, metal roofing offers homeowners the chance to choose from a multitude of colors and textures. Standing-seam steel roofing is the most popular residential metal roofing today. The term standing-seam describes the upturned edge of one metal panel that connects it to adjacent sections, creating distinctive vertical lines and a trendy historical look. But metal roofs can also be made to resemble wood shakes, clay tiles, shingles, and Victorian metal tiles. Aluminum or coated steel is formed into individual shingles or tiles, or into modular panels four feet long that mimic a row of shingles or tiles.

Metal roofs are durable, fire retardant and almost maintenance-free. They are also energy efficient. Research by the Florida Solar Energy Center showed that metal absorbed 34 percent less heat than asphalt shingles, and

homeowners switching to metal roofing reported saving up to 20 percent on their energy bills. Metal roofs typically have solar reflectance values between 0.50 and 0.70 but their overall efficiency is reduced by their low emittance levels, which means they trap solar radiation and don't emit the heat. They perform better when combined with a polymeric coating that helps to offset the low emittance of the metal. These coatings, which are similar to paint, can be factory-applied. It can be manufactured in long panels, or in smaller pieces that more closely resemble tiles or shingles.

The sound of rain on a metal roof, which some homeowners find unacceptable, can be reduced with the use of a foam underlayment.

The cost of metal roofing is initially higher than that of composition shingles, but it has a longer life cycle and can significantly lower heating and air conditioning costs, making a metal roof a very good investment. Furthermore, metal roofs are made from recycled metals (60% or higher), so they provide an environmentally friendly option.

Metal roofs are lightweight with typical installed weights ranging from 40 to 250 lbs. per square (100 square feet). Since they weigh very little, they can be installed over existing roofs, eliminating the need to dispose of excess material in a landfill. The reduced weight is of particular importance in high seismic zones where roofs can experience severe vertical and horizontal forces during an earthquake. The lightweight metal roof significantly reduces the chances of catastrophic failure or collapse of the roof structure during a massive quake. It is also fire resistant, making it suitable for use in fire-prone areas, and can result in reductions in the cost of insurance coverage.

Metal roofs are virtually maintenance-free. Periodic rinsing with a hose or pressure washer can help keep the surface clean and free of corrosive residue, such as bird droppings and acid rain. Although metal roofs can be walked on, care should be taken when walking on a roof with deep shake and tile profiles, to prevent damage to the contour of the ridges. Generally, the surface of metal roofs does not support the growth of algae.

Clay and Concrete Tiles

Clay tiles are most often thought of in the traditional "S" or "Spanish" tile look but clay can now be made in several other patterns as well. Tile is a very resilient material and is able to withstand some of the harshest elements such as hail, wind, and fire.

The one drawback to tiles is their weight; they are very heavy—typical weight ranges from 600 to 1,000 lbs. per square—and require certain structural standards for the frame and decking of the roof. Before replacing existing roofing with clay or concrete tiles, a careful evaluation of the existing framing structure is necessary.

Tiles have a great life expectancy, with a minimum duration of 50 years. Tile won't rot or burn and it can't be harmed by insects. Tile roofs offer one of the longest warranties in the roofing industry. Most tile manufacturers (both clay and concrete) will offer a minimum of a 50-year limited warranty on their products. Tile roofs are also energy efficient and fire resistant, suitable for use in fire-prone areas. Another advantage is their resistance to damage from both hail and high winds. Many insurance companies give a rebate to tile users because of the increased safety & weather resistance.

Tiles are fragile, so walking on them can break them. That makes standard roof maintenance such as painting or cleaning rain gutters or fireplaces challenging.

In terms of costs, clay tile is the high-end choice. It's molded, fired and, in some cases, glazed. It comes with up to 75-year warranties and sells for $300 to $500 and up per installed square. Tiles may need to be predrilled and nailed if you have a steep pitch roof, or even supported by metal brackets, all of which could increase the cost associated with this type of roofing system.

Concrete tiles have essentially all of the upsides of clay tile but with the added advantage of being available in an even greater number of styles. Cement roofing can be manufactured as S-tiles, villa tiles (low-profile tiles with a double S-shape), and flat tiles that often mimic the appearance of wood shake shingles or slates. One of the most durable roofing materials available, concrete components generally carry

a Class 'A' fire rating, making them a suitable choice for fire-prone areas.

Concrete tiles have good thermal performance due to their relatively high emittance and high reflectance, especially those that have a smooth, light-colored finish. Although difficult to quantify, there is an added benefit from the circulation of air around and under S-tiles.

While the production of concrete is very energy intensive, the long life cycle of concrete roof tiles at least partly offsets this impact. Because of their weight, the energy expended in their transportation is a consideration, but tiles are currently manufactured in those markets where they are most popular.

Attributes	Asphalt Shingles	Metal Roofing	Clay & Concrete Tiles
Cost	$50 to $150 / square	$100 to $600 / square	$300 to $500+ / square
Life-span and warranty	10 to 30 years	50 to 75 years	50 to 100 years
Durability	Low	High	High
Weight	240 to 400 lbs/square	40 to 250 lbs/square	Lightweight: 450 to 700 lbs/square Regular tiles: 900 to 1,200 lbs/square
Maintenance	High	Low	Low
Insurance premiums	–	reduced	Reduced
Recycled content	–	60% or higher	–
Energy efficiency	–	✓	✓
Material to landfill	–	Potentially less	–
Applications	Steep-sloped roofs – existing or new construction	Steep- or low- sloped roofs – existing or new construction	Steep-sloped roofs – new construction

Definitions

- Cost or weight per Square: cost or weight per 100 square feet
- Solar Reflectance is the fraction of the solar energy that is reflected by a roof, expressed as a number between zero and one. The higher the value, the better the roof reflects solar energy. For example, white reflective coating or membrane has a reflectance value of 0.85 (reflects 85% of solar energy hitting it and absorbs the remaining 15%), while asphalt has a value of 0.09 (reflects 9%).
- Emittance is the amount of absorbed heat that is radiated from a roof, expressed as a number between zero and one. The higher the value, the better the roof radiates heat.

- White Reflective Coatings contain transparent polymeric materials, such as acrylic, and a white pigment, such as titanium dioxide (rutile), to make them opaque and reflective. These coatings typically reflect 70 to 80% of the sun's energy. Despite the white appearance, these pigments strongly absorb the 5% or so of the sun's energy that falls in the ultraviolet (UV). Thus, the pigments help protect the polymer material and the substrate underneath from UV damage. As long as the coating is white or light-colored, the roof will have high reflectance and emittance levels.

For more information

- Energy Star List of Energy Star Roof Products; US Environmental Protection Agency: www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products
- The Cool Roof Rating Council (CRRC) is an independent organization that has established a system for providing building professionals with accurate property data on roof surfaces that may improve the energy efficiency of buildings while positively impacting the environment. www.coolroofs.org
- The Portland Cement Association represents cement companies in the United States and Canada. It conducts market development, engineering, research, education, and public affairs programs. www.cement.org/homes/ch_bs_roofing.asp
- Search Build It Green's **AccessGreen Directory** to find local suppliers and services: www.builditgreen.org

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