Houston Cool Metal Roofs

THERMALLY-ENGINEERED ROOF SYSTEMS FOR THE TEXAS CLIMATE

The Texas Smart Roof™: The Coolest Roof in Texas

It was a typical scorching summer day in Houston when the unthinkable happened, my central air conditioner went out! The repair man said my compressor had burned out and that it would a couple days until a replacement unit would be available. I remember thinking to myself it's just a few days, my family can live without a/c for a few days. Boy, was I wrong.

That first night was misery, and even with the ceiling fans and floor fans running full blast all night, it was hard for us to sleep. Unable to sleep, I went downstairs and saw that the temperature gauge in the living room said 101°F. It was after midnight, the sun had been down for almost four hours, and my house was still an oven inside! What was going on here?

A few mumbled cuss words later I decided to check the outside temperature, it was 80°F. We immediately moved a mattress and a few fans outside on the deck and slept "under the stars" that night. My mind still wouldn't let me sleep though, so I just watched the temperature gauge all

night. It reached a peak of 103°F at about 2 am, and by sunrise it was down to 93°F. Needless to say, I went and bought a window a/c unit for our bedroom when the store opened that morning.

Along with all the sweating I did that night, I also did a lot of thinking. I figured that, without air conditioning, my house would be unbearably hot under the relentless Texas sun in the afternoon, but why didn't it cool down at night?

It was though my home and all the other countless homes around me, were deliberately designed to absorb and trap the heat of the sun. While this design may work well in the northern latitudes, it was an absurd design for Texas. There had to be a better way, and so began my mission to understand the problems and find solutions for them. I would like to share what I learned with you below.

It's The Roof, Dummy

Though all this started with an air conditioner problem, I realized right away that the real problem was my roof. My home had the typical asphalt shingle roof that you see on just about every other house in Houston. As a roofing contractor, you didn't have to tell me that asphalt shingle roofs get scorching hot. I'm up on those roofs everyday and the darker the color of the shingle, the hotter the roof gets.

But if that wasn't bad enough, these asphalt shingles have another problem that make them unsuitable for our hot climate; they have a significant amount of thermal mass. This means that not only do they soak up the sun's heat like a sponge, but they also hold a tremendous amount of this heat for long after sunset.

Bingo!

Now I knew why my house was so hot that night. My roof absorbed heat all day, and then released its heat into the house at night. I had installed copious amounts of attic insulation years before, but this insulation doesn't completely block the flow of heat from the attic, it just slows it down. These two factors, the asphalt shingles and the attic insulation, explain why the peak 103°F temperature in my house that night didn't occur until 2 am.

Designing A Better Roof for Texas

So I began researching roof designs and materials that would provide much better protection against solar heat gain. My goal was to build a roof that would keep not only the house cool, but

also the attic space cool as well.

You see, most modern homes in this area have another common design problem; the air conditioning duct work is located in the attic space. Pushing 50° air through a 140° attic is probably not the brightest idea. Testing done by Florida Solar Energy Center showed that over 20% of the typical home cooling load comes from heat gain and leaks in the attic duct work.

In order to keep the attic space cool, I knew I needed a roof design that blocked as much of the sun's heat from entering the roof deck. This would be no small task, because the average 2000 sq. ft. roof can receive over 24 million BTUs of the sun's radiant heat per year in our climate.

In pouring over the research studies for cool roof design, I found three important design factors with proven abilities to reject the sun's heat:

- **Metal panels or coatings with a high solar reflectivity and emissivity**
- **Above-sheathing ventilation**
- **Above-sheathing radiant barrier**

Below I will describe each of these design factors and show how all three can work together to keep a home's attic and living space cool and protected from the sun.

Solar Reflectivity, Emissivity, and SRI

Most "cool roofs" that are built today use metal roofing panels that have been manufactured to reflect a large portion of the sun's radiant heat from their surface and away from the house. Depending on the color of the paint used, these panels can reflect anywhere from 20% (for darker colors) to 75% (white) of the sun's heat. When compared to dark asphalt shingles with a solar reflectivity of only 5%, metal roofing panels can make a real difference in keeping your home cooler.

Below is a chart from a manufacturer of metal roofing panels that lists the solar reflectivity values for their different color choices.

COLOR	Solar Reflectivity	Emissivity	SRI
Almond	67.10	0.90	82
Aged Bronze	29.66	0.86	30
Antique Copper Cote	29.30	0.85	29
Award Blue	17.20	0.83	12
Natural White	75.93	0.84	93
Bristol Blue	30.30	0.86	31
Buckskin	39.71	0.86	43
Burgundy	30.05	0.85	30
Champagne	34.95	0.85	36
Charcoal Gray	29.64	0.87	30
Colonial Red	33.03	0.85	34
Copper Brown	29.57	0.87	30
Copper Cote	45.24	0.87	51
Dark Bronze	28.20	0.91	30
Deep Red	38.54	0.84	41
Forest Green	29.08	0.85	29
Hartford Green	28.20	0.90	30
Hemlock Green	30.92	0.83	30
Lead Cote	32.90	0.90	35
Matte Black	28.70	0.91	30
Medium Bronze	31.39	0.85	32
Parchment	51.72	0.83	58
Patina Green	34.42	0.86	36
Preweathered Galvalume	33.61	0.80	32
Royal Blue	29.90	0.90	32
Shasta White	60.00	0.84	70
Sierra Tan	34.81	0.84	36
Teal Green	28.10	0.89	29
Terra Cotta	31.66	0.83	31
Zinc Cote	52.45	0.87	61
Zinc Grey	37.88	0.84	40
Satin Finish Galvalume	74.00	0.14	67
Acrylic Coated Galvalume	67.00	0.06	55

The chart also shows the emissivity and SRI (Solar Reflectance Index) values for each color are listed as well. The term emissivity refers to how well a material reradiates or reemits the heat that it has absorbed. The SRI is a calculation based on the solar reflectivity and emissivity values, and provides a value for how well a given material (or paint color in this case) rejects the sun's heat.The higher the SRI value, the cooler the roof panel stays under full sun.

From the chart we can see that the "natural white" metal roofing panel has the best SRI rating at 93, and the "award blue" panel has the worst at just 12. The color of a roof surface makes a huge difference in how cool it is. Does this mean if you want a cool roof you have to have a white roof? Not necessarily, as I will explain in a minute.

So the first line of defense against the sun's heat is to choose a roof surface that has a high SRI rating. This will minimize how much heat is absorbed by the roof surface and conducted into the home.

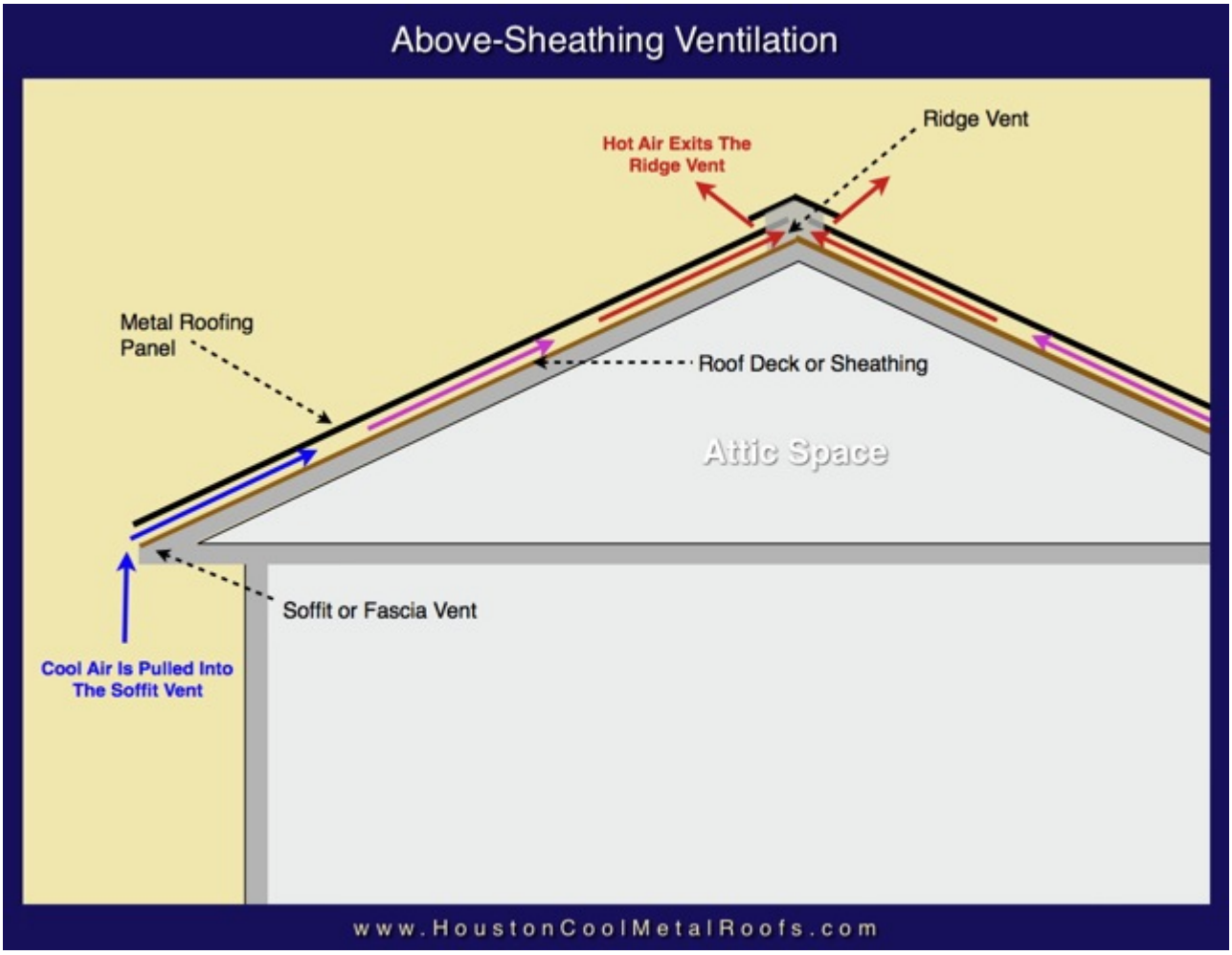
Above Sheathing Ventilation

Above sheathing ventilation (ASV) is simply a vented air space that lies sandwiched between the roof surface (metal roofing panels) and the roof deck or sheathing. Most homes these days utilize ridge vents and soffit vents for ventilating the attic space. ASV also uses ridge and soffit vents, but it ventilates a space above the attic, preventing much of the heat absorbed from the sun from ever entering the attic space.

Ventilation cools by a process called convective heat transfer. As air comes in contact with a hot object, some of the object's heat is transferred to the air, causing it to expand, become less dense, and rise.

In a roof with ASV, as the hot air rises and exits out the ridge vent at the top of roof, a convection current is created which pulls in cooler air through the soffit vents at the bottom of the roof. This type of passive ventilation is called a thermosiphon and is a very effective method for using the sun's heat itself to power the removal of heat from the roof structure. It's really a beautiful design and its cooling effect can be extremely powerful on a hot Texas day.

Because the ventilated air space lies just below the roof surface in an ASV roof design (and not in the attic), the air can come in direct contact with the hot metal roof panels. This creates a "supercharged" convective flow of air under the panels. The hotter the metal roof panels get, the faster the air flows and the more heat is removed before it can enter the attic.



Unfortunately, very few "cool roofs" are designed today with above-sheathing ventilation. In fact, many roofing contractors simply attach metal roofing panels directly to the roof sheathing and call it a "cool roof." Some roof contractors do create an air space between the panels and the roof deck, but they do this by placing battens horizontally (side to side) across the roof. These horizontal battens under the metal roof panels effectively block the flow of air from the soffit vents up to the ridge vent, preventing any thermosiphonic ventilation from occurring above the roof sheathing.

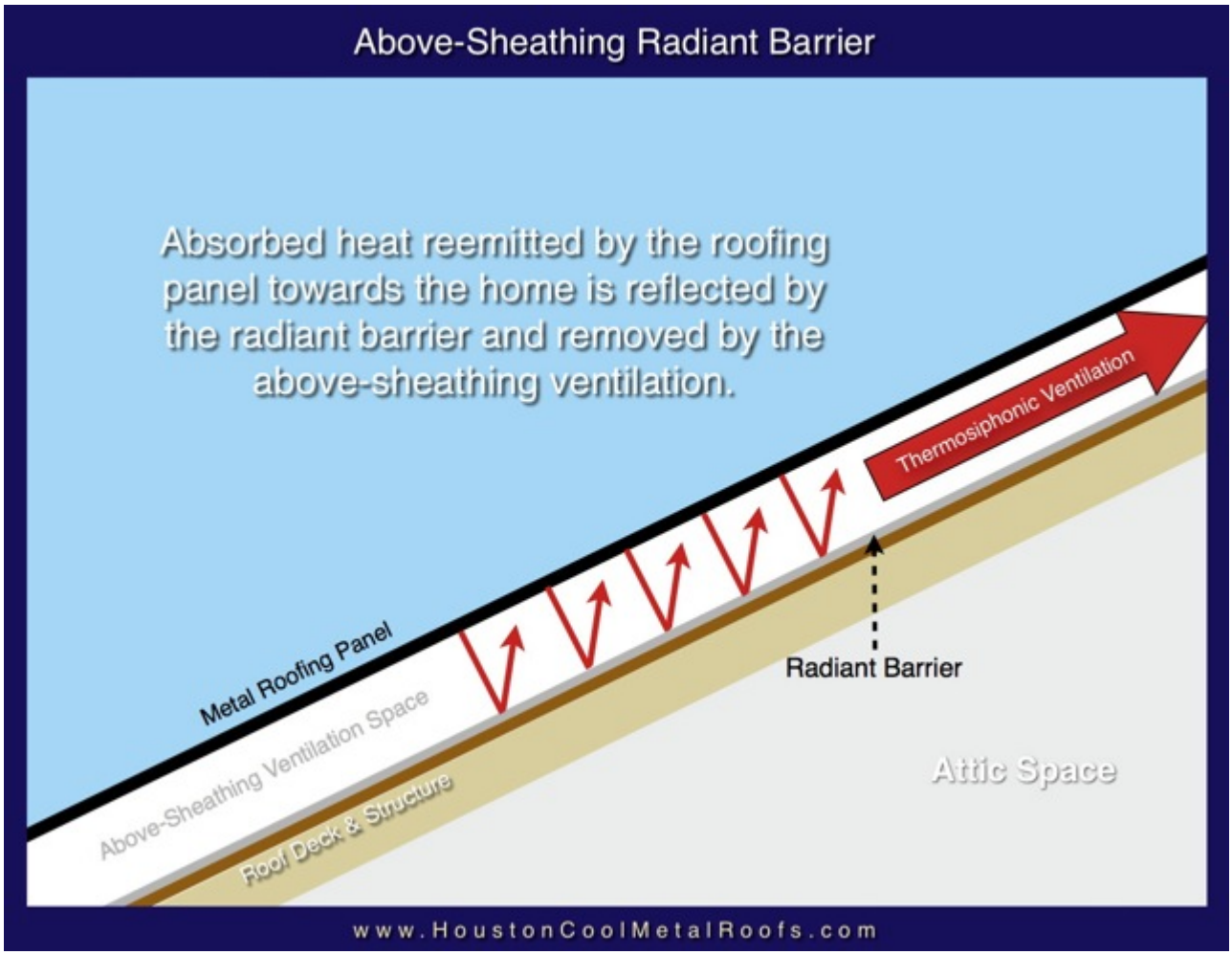
Properly designed above-sheathing ventilation is an essential component of a thermally engineered roof system, and forms the second line of defense against the heat of the sun.

Above-Sheathing Radiant Barrier

Most people are familiar with the use of a radiant barrier in an attic space, which involves stapling sheets of radiant foil to the underside of the roof rafters. This type of installation can help to keep your home cooler but it does have its problems.

The primary problem with this type of installation is that the heat has already entered the attic and is being conducted through the house's structure before it is reflected by the radiant barrier. Also, the heat that is reflected by the barrier is directed back into the roof deck and structure, making it even hotter. Finally, it can be difficult to install a continuous barrier in an attic space, and some roofs may not have an attic space under all parts of the roof.

A much more effective use of a radiant barrier is to place it above the roof deck so it can reflect the radiant heat before it enters the roof deck. The most important design consideration in a radiant barrier installation is creating an air space between the barrier and the source of the radiant heat. Without this air space, the radiant barrier cannot work because the heat flow will be conductive in nature rather that radiative.



Many roofing contractors use a type of roof sheathing that has radiant foil attached to one side. They then proceed to attach shingles directly on the radiant barrier with no airspace in between. Installed in this manner, the radiant barrier is completely useless as the heat from the shingles is conducted right through the radiant barrier to the roof deck.

Other contractors will place the foil side of the roof sheathing down, facing into the attic space. Used in this way, the radiant barrier will trap heat in the attic. This may be desirable in a cold climate, but in south Texas, it's a recipe for huge air conditioning bills.

Above-sheathing radiant barriers can reflect 97% of the radiant heat away from your home. Installing a radiant barrier below the metal roof panels, and within the above-sheathing ventilation space has two huge benefits:

- First, the radiant heat being reemitted by the metal roofing panel is blocked from entering the home and reflected back towards the panel. This causes the temperature of the metal roofing panel to rise even higher, providing more "fuel" to power the thermosiphon ventilation under the panel.
- Second, having a radiant barrier under a metal roof panel means that the color of the panel doesn't necessarily have to be white for the roof to have good solar reflectivity. Darker color roof panels will absorb more of the sun's radiant heat, but an above-sheathing radiant barrier will reject a large amount of this absorbed heat before it can enter the home.

A radiant barrier, placed above the roof deck, is the final line of defense against the hot Texas sun, and can significantly enhance the performance of the metal roof panels and above-sheathing ventilation components of the cool roof.

A Cool Roof That Performs Well In The Winter ?

The major drawback to traditional cool roofs is their poor performance during the cold winter months. While cooling costs can be dramatically reduced with a cool roof, the cost to heat the home in winter will increase because the sun cannot supply heat to the home through the roof.

The good news is that a cool roof with above-sheathing ventilation actually performs much better during the winter than a typical cool roof. In testing done by the Oak Ridge National Laboratory in 2006, it was found that above-sheathing ventilation negated the heating penalty associated with cool roof designs.

This is because the air space underneath the roof acts as a conduction block for heat flowing between the metal roof panels and roof deck in both directions. So the home with a ventilated cool roof doesn't gain heat like a home with an asphalt shingle roof on winter days, but it also doesn't lose radiant heat to the sky on winter nights. The end result is that the ventilated cool roof performs about the same as the traditional asphalt shingle roof during the winter.

The Texas Smart Roof™ is Born

So there you have it, a cool roof designed to keep your attic and home cool, and take a huge load off of your air conditioner. I call it the Texas Smart Roof™ because it just makes good sense in so many ways:

- It minimizes how much of the sun's heat is absorbed by the roof and transmitted into your home.
- It harnesses the sun's heat itself to passively power the removal of absorbed heat from the roof. The hotter it gets, the greater the cooling from ventilation .
- It uses a radiant barrier in the most effective way, providing an uninterrupted blanket of shade over the entire home.
- It negates the extra heating expense associated with typical cool roofs in the wintertime.
- It has at least three times the lifespan of an ordinary asphalt shingle roof, making it the last roof that you will probably ever buy for your home.
- It can pay for itself in utility bill savings alone.
- Its metal roofing panels are 100% recyclable, making it a smart choice for the environment.

It has been a lot of work developing this roof design over the years, but to be able to build a business around a product that I wholeheartedly believe in, has been worth all the effort. And to think all this happened because my air conditioner went out one day. I guess you just never know.

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If you live in the Greater Houston Area (or South Texas) and would like a free quote for a new roof from us, please call Patrick Bulot of South Shore Roofing at **(832) 640-7986** or use the email below:

My dream of the Texas Smart Roof™ would have never been realized without the hard work and know-how of one man, Patrick Bulot. Pat is truly a mechanical genius. He is also very down-to-earth and easy going. A man with this combination of character and ability is pretty rare these days, so I'm happy to be able to call him a friend. I …

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