BASF Polyurethane Foam Enterprises LLC

The Chemical Company

Memo

To: To Whom It May Concern

From: Jim Andersen, Technical Applicators Manager

CC: B. Schenke, K. Frauenkron

Date: 8/1/2006

Re: Non-Vented Construction

Most codes require ventilation for attic construction. The use of "hot roof" or unvented roof construction has become widely used for the last several decades. Closed-cell spray polyurethane foam (SPF) works well for cathedral ceilings and hot roof construction whereby the insulation is installed directly to the bottom side of the roof sheathing and there is no ventilation. The roof and wall junctions must be air tight for this insulation system to work. The spray application of our closed-cell polyurethane will absolutely provide an air barrier when properly installed. The total seamless, rigid air barrier does not allow wind driven snow or moisture to penetrate into the building envelope. The airtight construction requires a mechanical ventilation system that controls the humidity levels and air changes within the home.

I have provided two technical articles that will provide documentation for this unvented construction. We hope that field inspectors will have enough information here to allow the non-vented use of SPF in these applications. Recent code changes to the International Codes are allowing for unvented conditioned attic assemblies under specific provisions, which includes the use of our product. If you need more information for your decision, please feel free to call 1-800-888-3342 and ask for technical sales.

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Helping Make
Buildings Better™

UNVENTING ATTICS IN COLD CLIMATES

BY JOSEPH LSTIBUREK

Build your cold-climate attic with no vents—the shingles may not last quite as long, but you'll get big payoffs in performance and energy savings.

As *Home Energy* readers know, venting attics in hot, humid climates brings a great deal of moisture into the structure (see "Conditioned Attics Save Energy in Hot Climates," *HE* May/June '97, p. 6). Not venting the attic avoids this problem.

What is less well understood is that venting causes many problems in cold (dry) climates, as well. For example, it allows a great deal of snow to blow in—especially the really fine snowflakes that weigh less than raindrops. Not venting also avoids this problem. Finally, as most builders know, venting roof assemblies can be extremely difficult for roof designs with complex geometries. Not venting avoids these difficulties, too.

Overcoming the Objections

I can hear the objections: What about moisture? What about sheathing temperature and shingle temperature in the summertime? What about the energy costs? What about the code?

First, take moisture: People usually vent attics in cold climates to prevent moisture accumulation in the roof sheathing and control ice dams. In cold climates, moisture in roof assemblies typically comes from inside, and the key to problems with moisture is the temperature of the roof sheathing.

Unvented attics have higher temperatures on the underside of the roof sheathing. If this area—typically the first condensing surface—is kept above the dew point temperature of the interior air-vapor mix, condensation and moisture accumulation will not occur (see Figures 1 and 2).

Ice damming can be controlled by reducing heat flow to the shingles through air sealing and insulating to more than R-40, rather than by flushing heat away from the roof shingles with venting. The net effect is the same—the roof shingles are cold—but by eliminating venting, we save a great deal of energy.

Warming Up to Unvented Roofs

The underside of the roof sheathing is where the real benefits of not venting roof assemblies are found. Our field measurements and computer modeling

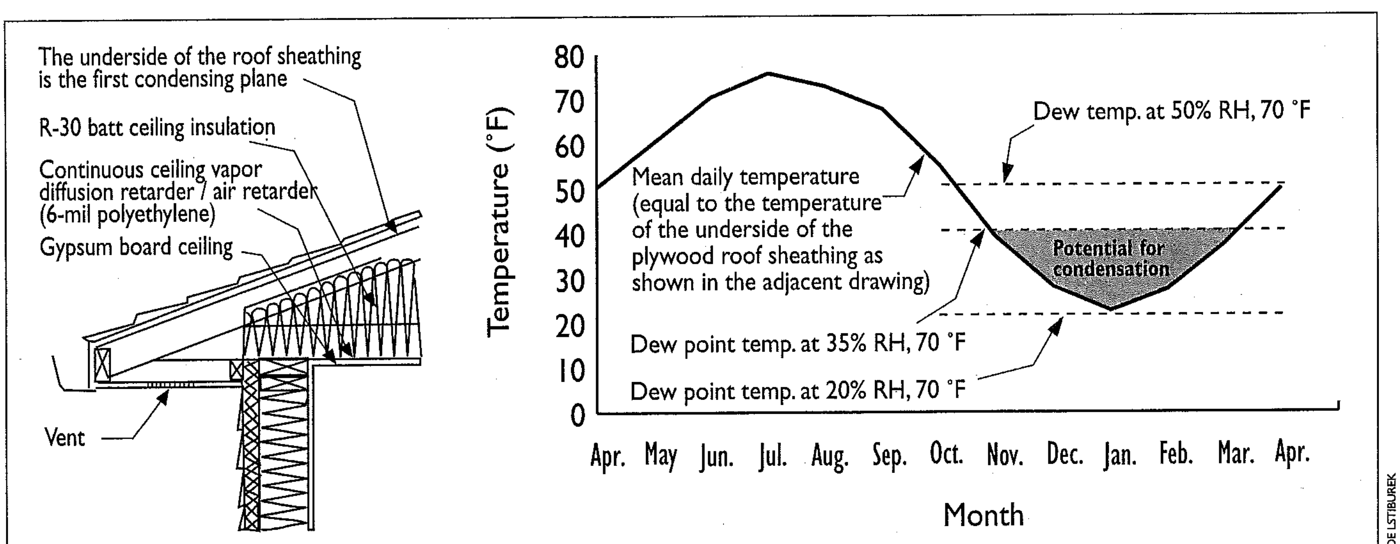

Figure 1. Potential for condensation in a roof assembly in Chicago, Illinois. The roof assembly has R-30 fiberglass batt insulation and a vented attic space. By reducing interior moisture levels, the potential condensation is reduced or eliminated.

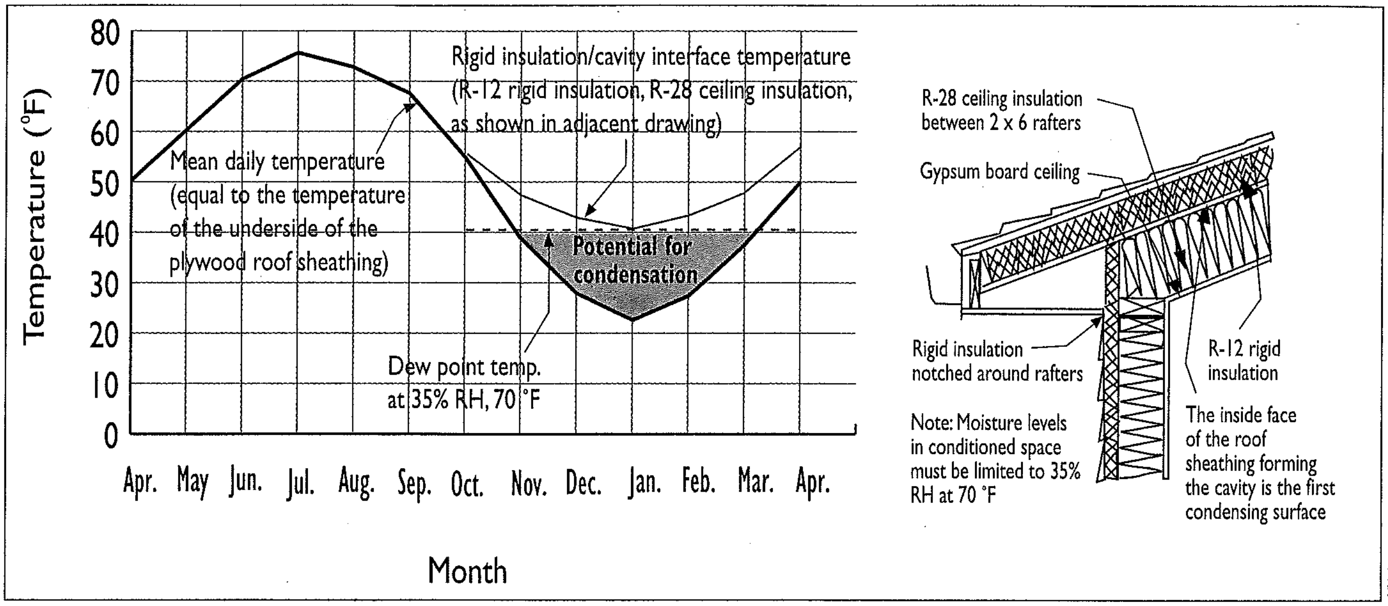

Figure 2. Potential for condensation in a roof assembly in Chicago, Illinois. The unvented cathedral ceiling has R-12 rigid insulation above R-28 batt insulation. The R-12 insulating sheathing raises the dew point temperature at the first condensing surface so that no condensation will occur with interior conditions of 35 % relative humidity at 70°F.

show that, without attic venting, the temperature of the underside of the roof sheathing increases by 10°F–20°F.

In cold climates, this is an advantage. Unventing roof assemblies in most cold climates decreases the heating load by about 10%. That answers the energy question: Unventing attics in cold climates saves energy.

What about shingle temperature? Well, the answer to that question is, Don't use asphalt shingles. They have many disadvantages anyway. They burn. They are sensitive to ultraviolet light. They can't be made to last more than 15 to 20 years—despite what the warranty says. Hail just kills them, and they off-gas horrible stuff. But they are cheap. And in cold climates, they are the roof covering of choice.

When attics with asphalt-shingled roofs are left unvented, the operating temperature of the shingles increases slightly—on the order of 2%–3% of absolute temperature. This means that a black asphalt shingle roof that is typically at 150°F will be at 153°F–155°F. That 3°F–5°F increase can be important, since it translates into an approximate 15% reduction in the useful service life of the shingle. On a 15-year shingle roof, that means you may lose 2 to 3 years in service life.

Why is there only a 3°F–5°F increase in asphalt shingle temperature? Because radiation is the dominant factor in heat transfer through roof assemblies, and venting the roof does not affect the radiation heat transfer. Also, the underside of the roof sheathing is not an efficient plywood-to-air heat exchanger, so venting is of little importance in reducing shingle or sheathing temperature.

Vapor, Not Vents

Although there clearly are potential benefits from attic vents in heating climates, there are also disadvantages: Vents can be prone to snow and rain entry that can wet the insulation, and cold air blowing through eave vents can degrade the thermal performance of attic insulation. . . . In heating climates, attic ventilation usually provides a measure of protection from excessive moisture accumulation in the roof sheathing, but if indoor humidity is high and humid indoor air leaks into the attic, the use of attic vents does not guarantee that attic moisture problems will not develop. Therefore, moisture control in attics in heating climates depends primarily on maintaining low indoor humidity levels during cold weather and on ensuring sufficient airtightness and vapor resistance (i.e. a vapor retarder) in the ceiling.

—*1997 ASHRAE Handbook, Fundamentals, 23.6*

Code Catch-Up

I have about 1,000 unvented shingled roofs under my belt. Most of them are in Canada—yeah, I know, the laws of physics are different up there—but a lot of them are in New England, Michigan, and Colorado. More than a third of them are now over ten years old, and they are doing fine.

The biggest problem with building these unvented attics has been building codes. The codes do not like unvented roof assemblies. But changes are coming. First it was the 1997 edition of ASHRAE Fundamentals—it likes unvented roof assemblies (see "Vapor, Not Vents"). Then we (the Building America guys and gals) changed the building code in Las Vegas. We have more than 300 unvented roof assemblies constructed there so far.

I predict that, in five years, the codes everywhere will have changed.

Joseph Lstiburek is an engineer and the principle investigator for the Building Science Consortium, a partner in the Department of Energy's Building America program.

March 2002

Professional Roofing

What's the value of ventilation

A study of asphalt shingles demonstrates ventilation may not be as important as other variables

by ***Carl G. Cash, PE, and Edward G. Lyon, PE***

The topic of asphalt shingles splitting and cracking has received much attention lately. Asphalt fiberglass shingles have been experiencing vertical splits, as well as horizontal splits in exposed tabs. These dislocations, called thermal splits, are the subject of a great deal of litigation, including class-action lawsuits. The splits are not associated with quality of installation. Rather, the splits occur in shingles where self-sealing adhesive firmly adheres the shingle tabs and a shingle's tear strength is low or inadequate to withstand a thermally or mechanically induced load.

Whenever asphalt fiberglass shingle manufacturers are faced with thermal-splitting problems, one excuse they usually offer is that the area under a roof deck was not ventilated properly.

This excuse is offered not because there is any evidence of a cause-and-effect link between thermal splitting and ventilation but because shingle warranties (all the shingle warranties listed in NRCA's *2002-03 Steep-slope Roofing Materials Guide*) specifically exclude warranties in the case of "inadequate attic ventilation." This is based on the premise that shingles applied to decks over unventilated attics will be unacceptably hotter than shingles applied to decks over properly ventilated attics and have significantly shortened service lives as a result of the increased temperature.

Lawyers say impractical or unreasonable contract or warranty provisions may not be supported by court decisions. The following information reveals results from a study we conducted that investigated the reasonableness of the "inadequate attic ventilation" exclusion in warranties.

Some parameters that can influence roof temperature are geographic location, color, exposure orientation, slope and degree of attic ventilation. We report the means (averages) of the maximum and average annual temperatures of the roofing materials for each combination of these parameters.

Geographic location

The National Oceanic and Atmospheric Administration lists 264 locations in the United States that are representative of all U.S. climates. The locations range from Key West, Fla., with the warmest average annual temperature (79 F [26 C]), to Barrow, Alaska, with the coldest average annual temperature (9 F [-13 C]).

Previous research by Cash has shown temperatures plotted on a graph form a sinusoidal wave that is equally balanced (symmetrical) around the average temperature at each location. Therefore, mean temperature is an accurate index of a thermal environment.

For this study, we used the following seven locations (we excluded the West Coast because of its mild temperatures) to study the variation of roofing materials' temperatures with respect to geographic location (mean temperatures for each location are noted):

- Boston—51 F (11 C)
- Chicago—53 F (12 C)
- Green Bay, Wis.—44 F (6.5 C)
- Phoenix—70 F (21 C)
- Raleigh, N.C.—59 F (15 C)
- Miami—76 F (24 C)
- Washington, D.C.—57 F (14 C)

Study details

We used white and black shingles in our study. The materials' albedos (overall measure of a material's reflectivity to the full spectrum of the sun's energy) and emmissivities (percent of absorbed energy a material can radiate away from itself) used were obtained from measurements at the Lawrence Berkeley National Laboratories, Berkeley, Calif.

We limited our calculations to roof surfaces facing the following orientations: 90 degrees east, 135 degrees southeast, 180 degrees south, 225 degrees southwest and 270 degrees west.

In addition, we calculated the temperatures of roofs with slopes of 3-in-12 (14 degrees) to 12-in-12 (45 degrees) in 12.5 percent (1-inch-per-foot) increments. In this article, we only report the calculated results in 25 percent (3-inches-per-foot) increments because these calculated temperatures are close to each other.

Our calculated roof temperatures are reported without ventilation; with attic ventilation provided by 0.33 percent ventilated areas (1 square foot for each 300 square feet of attic plan area) and wind perpendicular to roof slope (no wind assistance to ventilation); and with 0.33 percent ventilated areas (1 square foot for each 300 square feet of attic plan area) and wind normal to the roof orientation (maximum ventilation assistance from wind).

Computer input

As the model for our calculations, we used the Hastings Ranch House referenced in "Analytical Study of Buildings with reflective roofs," published by the National Institute of Standards and Technology. We chose a cathedral ceiling rather than truss-attic space to maximize the difference between ventilated and unventilated roof temperatures. The ceiling-to-roof covering assembly construction we used was as follows:

- 1/2-inch- (13-mm-) thick gypsum drywall sheathing
- 10-inch- (254-mm-) thick fiberglass batt insulation between joists 16 inches (406 mm) on center
- 2-inch- (51-mm-) thick clear air space (to maximize the venting air effect, we did not use an air-friction value in any calculation)
- 5/8-inch- (16-mm-) thick plywood sheathing
- No. 15 asphalt felt and asphalt fiberglass shingles

The mathematical model calculates heat gain and loss for a width of roof extending from eave to ridge. The properties of each layer of the roof assembly are lumped together to create a calculation node.

For our model, we subdivided the insulation layer into thin sections and assumed a uniform 70 F (21 C) interior temperature. We then calculated the heat transfer between nodes in small-time increments because exterior temperature varies through a sinusoidal wave function based on average monthly conditions.

We used the average monthly cloud conditions to modify the solar equations in "Solar Engineering of Thermal Processes," by J.A. Duffie and W.A. Beckman, to reduce solar radiation gain by up to 60 percent and nighttime radiation cooling by 100 percent for full overcast cloud conditions. The potential for snow cover to reduce daily roof temperature cycles was not considered in this study.

We also calculated dew-point temperatures required for radiation gain and loss from a sinusoidal temperature and relative humidity function based on observed monthly average conditions. Average local wind speeds were adjusted from airport observation height and exposure conditions to an urban exposure at a 10-foot (3-m) eave height. Wind speed was used to calculate roof convective heat-flow coefficients, as well as its influence on roof ventilation.

In addition, we calculated ventilation airflow by applying the pressure developed by ventilated space and outdoor air temperature differences (stack effect), wind effects, and airflow resistance of screened openings at the eave and ridge. (We divided the ventilation area equally between the eave and ridge.)

During the study, wind blew either at an angle that maximized the pressure developed on the vents or at an angle that did not influence the stack-effect pressures. The ventilated space had no resistance in these calculations to maximize the effect of ventilation.

For unventilated roof systems, the calculated temperatures are representative of an entire roof system. For ventilated roof systems, the calculated temperatures are representative of a point halfway up a roof system.

Air movement would make eave and ridge areas slightly warmer or cooler than the calculated temperature depending on airflow direction. The maximum roof temperature at any point for ventilated roof systems will not exceed the temperature of unventilated roofing materials.

Ventilated roofing calculations required a small time adjustment for calculations to remain stable. Because of calculation time constraints, we modeled one day in the middle of each month as representative of monthly average conditions. We started our calculation model at a uniform average layer temperature for a particular month and allowed a complete day calculation cycle for the assembly to normalize. We then calculated a second day cycle to generate peak and mean temperature values for the month. The yearly mean temperature was calculated by a weighted average of the monthly calculations.

Computer simulations often require correlation testing before being accepted as absolute predictors of real-world conditions. In our case, the goal was not to attempt to precisely predict a particular roof temperature but to study the "all other things being equal" thermal performances of different ventilation systems. Ventilation obviously will reduce roof temperature, and we have attempted to generously model the airflow potential of ventilated roof systems to define an outer boundary for cooling effects.

Previous work by Cash developed a thermal model and empirical relationship between a roof system's average service life and mean annual temperature to which roofing materials are exposed. In the case of asphalt shingles, a change of 1 degree Celsius is about equal to one-fourth of a year in average service life.

Data and results

Some data generated in the study are listed in Figures 1 to 4. The calculated temperatures are reported to two decimal places-not to imply an accuracy that does not exist but because some differences otherwise would be too small to distinguish.

The average roof temperature difference between roofing materials on unventilated decks and ventilated decks and difference between the temperature of roofing materials on unventilated decks and wind-assisted ventilated decks are listed in Figure 1.

Location	Unventilated vs. 1/300 plan ventilation		Unventilated vs. wind-assisted ventilation	
	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit
Boston	0.44	0.79	0.77	1.39
Chicago	0.54	0.96	0.84	1.50
Green Bay, Wis.	0.55	0.99	0.85	1.53
Miami	0.52	0.93	0.75	1.35
Phoenix	0.54	0.98	0.69	1.24
Raleigh, N.C.	0.61	1.10	0.82	1.48
Washington, D.C.	0.60	1.09	0.83	1.49

Figure 1: The average roof temperature differences between unventilated and ventilated decks and unventilated decks and decks with wind-assisted ventilation

Figure 2 lists the variations in average roof temperature caused by changing roof system color from black to white shingles.

Location	Unventilated		1/300 plan ventilation		Wind-assisted ventilation	
	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit
Boston	1.22	2.20	1.11	2.00	1.07	1.92
Chicago	1.35	2.42	1.20	2.17	1.18	2.12
Green Bay, Wis.	1.32	2.39	1.20	2.15	1.16	2.09
Miami	1.50	2.70	1.36	2.45	1.33	2.39
Phoenix	1.67	3.01	1.51	2.72	1.49	2.69
Raleigh, N.C.	1.53	2.76	1.38	2.48	1.36	2.44
Washington, D.C.	1.53	2.76	1.38	2.48	1.35	2.44

Figure 2: The variation in average roof temperature as a result of color change between black and white shingles

Our data show roofs that face west have the lowest roof temperatures of those measured. We are quite sure roofs facing northwest, north or northeast would have lower temperatures, but western-facing roof temperatures are the lowest we calculated. We found the highest mean roof temperatures in south-facing roofs. The maximum difference between mean roof temperature of roofs facing south and west can be found in Figure 3.

Location	Unventilated		1/300 plan ventilation		Wind-assisted ventilation	
	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit
Boston	1.31	2.36	1.19	2.14	1.15	2.06
Chicago	1.46	2.58	1.31	2.37	1.29	2.32
Green Bay, Wis.	1.49	2.68	1.34	2.41	1.31	2.35
Miami	1.06	1.90	0.96	1.73	0.93	1.68
Phoenix	1.74	3.14	1.58	2.84	1.56	2.81
Raleigh, N.C.	1.52	2.74	1.37	2.47	1.35	2.43
Washington, D.C.	1.49	2.68	1.34	2.41	1.32	2.37

Figure 3: The maximum difference in mean roof temperature of roofs facing south and west

The slope with the maximum and minimum mean roof temperatures varied with location and slope. Figure 4 shows the maximum variation in mean roof temperature calculated for slopes of 3-in-12 (14 degrees) to 12-in-12 (45 degrees).

Location	Unventilated		1/300 plan ventilation		Wind-assisted ventilation	
	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit	Degrees Celsius	Degrees Fahrenheit
Boston	0.14	0.25	0.09	0.16	0.15	0.28
Chicago	0.19	0.35	0.17	0.31	0.26	0.46
Green Bay, Wis.	0.16	0.29	0.10	0.19	0.18	0.32
Miami	0.39	0.70	0.55	0.98	0.31	0.55
Phoenix	0.21	0.38	0.15	0.26	0.20	0.35
Raleigh, N.C.	0.18	0.32	0.26	0.46	0.18	0.33
Washington, D.C.	0.15	0.26	0.09	0.15	0.15	0.27

Figure 4: *The maximum variation in mean roof temperature for slopes of 3-in-12 (14 degrees) to 12-in-12 (45 degrees).*

We also wanted to determine the maximum monthly roof temperature (hottest roof system) and greatest temperature difference with 1/300 ventilation (best ventilation) for each location.

For the roof systems with black shingles, we studied maximum roof temperature; temperature differences for ventilated, ventilated with wind and change to unventilated white shingles; yearly mean temperature; and mean temperature differences for ventilated and change to unventilated white shingles.

We found roof temperature extremes do not relate directly to mean temperatures for service life. In all instances, changing roof color from black to white has more effect on yearly mean temperature than ventilation. Ventilation reduces the yearly mean temperature of a black roof system by an average 0.7 degrees Celsius, and changing to white shingles reduces the yearly mean temperature by an average 1.6 degrees Celsius.

Conclusions

The following conclusions are based on data from our numerical model:

- The greatest influence on roof temperature is geographic location. The mean roof temperatures for Miami and Green Bay, Wis., for example, differ by 18 degrees Celsius.
- The direction a roof faces has the second greatest influence on average roof temperature (in excess of 1.44 degrees Celsius in the east through south-to-west range studied, but the real difference is greater because other directions, such as north, will be cooler).
- The color of roofing materials influences the mean temperature of a roof system slightly less than direction (1.45 degrees Celsius average for these parameters).
- Ventilating the area under a roof deck reduces the average temperature 0.5 degrees Celsius (about one-third the influence of the direction or color and one-thirty-sixth the influence of geographic location). Even with wind assistance, ventilation reduces average roof temperature about half as much as using white rather than black shingles.
- Within the ranges studied, slope has the least influence on average shingle temperature.

Many shingle manufacturers provide warranted products that are widely distributed and are of many colors and exclude from warranties those shingles installed on unventilated decks. This exclusion has no justification; the variations in geography, direction and shingle color have greater influences on average temperature than the degree of ventilation.

However, ventilation should be recommended to remove the small quantity of moisture in a roof system; it can prolong the life of a wood deck even if it does not extend the life of shingles.

Carl G. Cash is a principal with Simpson, Gumpertz & Heger Inc., Arlington, Mass., and Edward G. Lyon is a senior staff engineer with Simpson, Gumpertz & Heger.

Spray Polyurethane Foam (SPF)
and
Cathedral Roofs & Cathedralized Attics

SPRAY POLYURETHANE FOAM ALLIANCE
SPFA
a Business Unit of the
American Plastics Council

This document was developed to aid in the use of SPF in Cathedral roof/attic applications. The information provided herein, based on current customs and practices of the trade, is offered in good faith and believed to be true, but is made WITHOUT WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO FITNESS, MERCHANTABILITY, OR ANY OTHER MATTER. APC DISCLAIMS ALL LIABILITY FOR ANY LOSS OR DAMAGE ARISING OUT OF ITS USE. Individual manufacturers and contractors should be consulted for specific information. SPFA does endorse the proprietary products or processes of any individual manufacturer, or the services of any individual contractor. APC does not endorse the proprietary products or processes of any individual manufacturer, or the services of any individual contractor.

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BUILDING ENVELOPE COMMITTEE (BEC)

SPRAY POLYURETHANE FOAM ALLIANCE

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a Business Unit of the American Plastics Council

Spray Polyurethane Foam (SPF) And Cathedral Roofs & Cathedralized Attics

Closed cell, spray polyurethane foam (SPF) may be used to construct unvented cathedral roofs and cathedralized attics. It can be applied in sufficient thickness to satisfy local energy code requirements, directly to the underside of roof sheathing between rafters or joists of any slope in all (heating, mixed and cooling) climates.

This configuration controls the entry of moisture-laden air into the insulation and also eliminates dew-point occurring at the underside of the roof deck and anywhere in the insulation, in all (heating, mixed or cooling) climates*. Due to the fully adhered, closed cell properties of SPF, air and moisture are displaced out of the insulated space – including at rafters and sheathing. Moisture cannot enter the insulated space from any direction, eliminating the requirement for roof venting.

Venting above the closed cell SPF could reintroduce moisture laden air into a new air space below the roof sheathing, which may introduce another moisture condensation problem. Therefore, venting above the SPF in these configurations is not recommended.

*(Assumes the suitable thickness of SPF is applied to prevent condensation)

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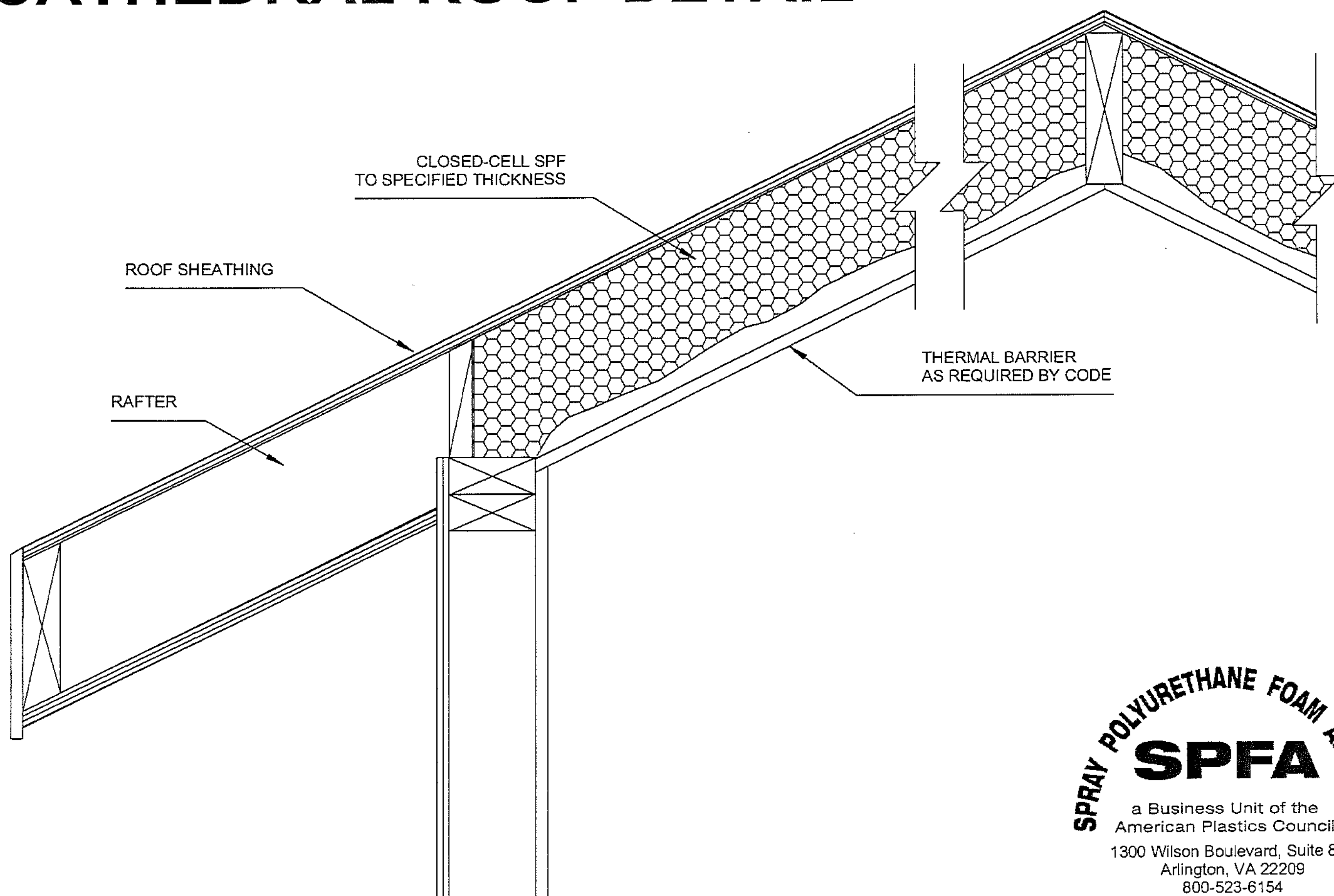
CATHEDRAL ROOF DETAIL



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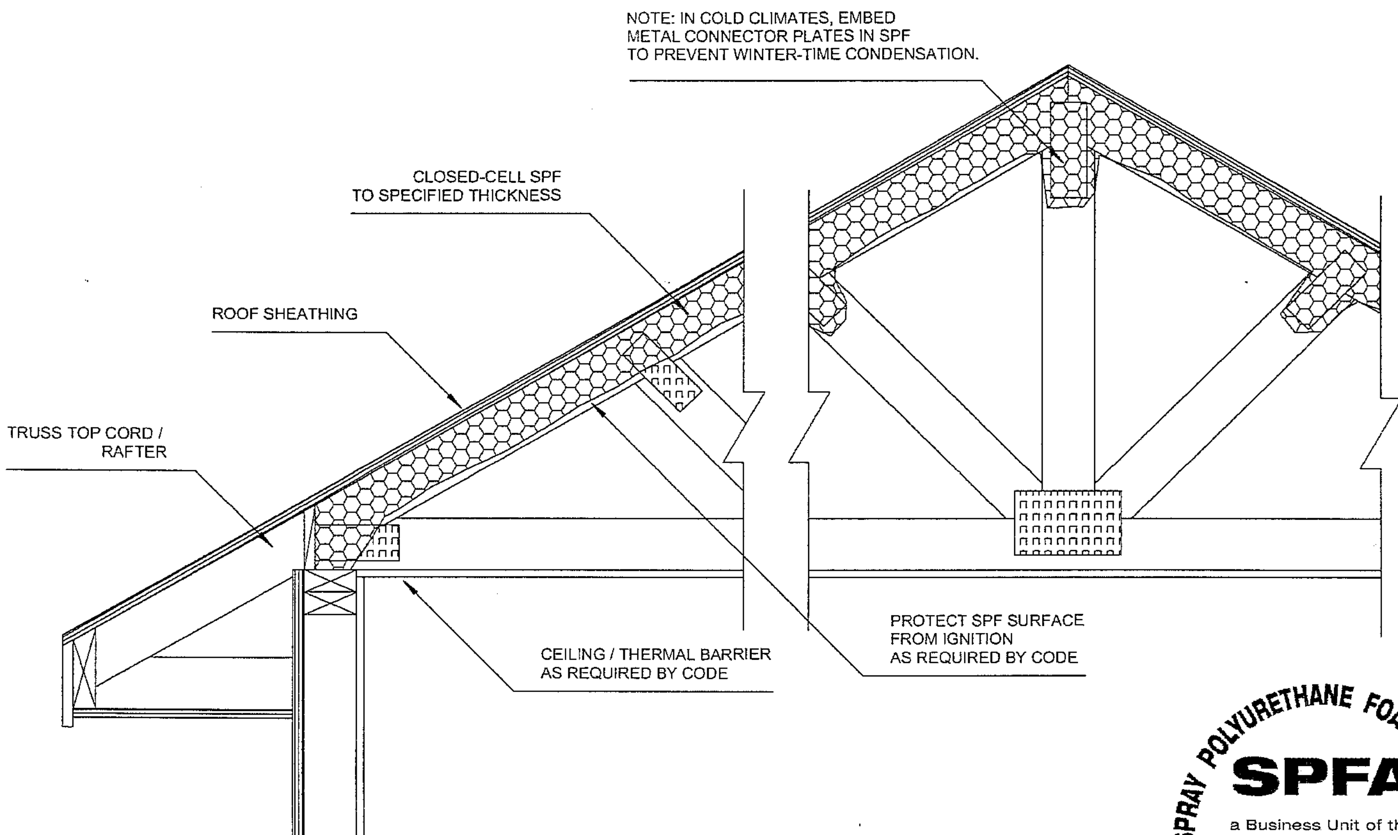
CATHEDRALIZED ATTIC DETAIL



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In short, specifying that ducts should be installed within the conditioned space is easier said than done. Although Zoeller's tone is war-weary, he retains his sense of humor. "We've been messing around with all kinds of ways to do this—dropped soffits, plenum trusses, burying ducts in attic cellulose or polyurethane foam," he says. "We've tried different systems, proved them, and messed up, again and again. We understand the limitations of all the systems out there."

Instantaneous Hot Water

Since no one wanted to cut down the mature shade trees on the model house lot, a solar water heater was ruled out. Instead, domestic hot water is provided by a natural gas Takagi instantaneous water heater with a flow rate of up to 6.9 gallons per minute. The sealed-combustion unit has a 3-inch combustion air duct and a 4-inch flue vented through the roof. The water heater has electronic ignition, and therefore no wasteful pilot light.

Since the heating load in Gainesville is relatively low—Gainesville has a design temperature of 32°F—heat is provided by a fan/coil unit (an Aquecoil unit from Trevor-Martin Corporation) supplied with hot water from the water heater. "Since the Takagi unit has a capacity of 168,000 Btus per hour, it can handle the domestic hot water load in addition to the hydrocoil load without a problem," says Zoeller. Using the water heater for heat avoids the cost of a furnace; however, a condensing furnace would have been more energy-efficient. According to Zoeller, "A condensing furnace would be overkill in Gainesville."

All interior lighting fixtures have fluorescent tubes or compact fluorescent bulbs, and all appliances have the Energy Star label. To maintain high indoor air quality, the house has no carpeting.

Energy Use

The house has achieved a HERS score of 92. When some last-minute air sealing work is completed, Jones expects the HERS score to rise to 94.5.

Because of its tight, well-insulated envelope, as well as its high-performance windows, the Madera house has very low heating and cooling loads. Moreover, those loads are satisfied by relatively efficient HVAC equipment. Computer modeling by the CARB team projects that the house will use 70% less energy for heating, cooling, and domestic hot water than a conventional house (that is, a house with 2x4 walls, R-13 wall insulation, R-19 attic insulation, a 78% AFUE furnace, and a SEER-10 air conditioner). Its total energy use—including lighting, appliances, and "plug loads"—is expected to be about half that of a conventional home.

Jones predicts that the home will sell for about $364,000. He estimates that the home's energy-efficiency features added about 7% to the home's construction costs.

For more information, contact:

Eco-Block, P.O. Box 14814, Fort Lauderdale, FL 33302. Tel: (800) 595-0820 or (954) 766-2900; Fax: (954) 761-3133; Web site: *www.eco-block.com.*

Pierce Jones, University of Florida Energy Extension Service, P.O. Box 110940, Gainesville, FL 32611-0940. E-mail: ez@energy.ufl.edu.

Jordan Windows & Doors, P.O. Box 18377, Memphis, TN 38181-0377. Tel: (901) 363-2121; Fax: (901) 362-5051; E-mail: custserv_ewd@jordancompany.com; Web site: *http://jordancompany.com.*

Takagi USA, 3-B Goodyear, Irvine, CA 92618. Tel: (888) 882-5244 or (949) 770-7171; Fax: (949) 770-3171; Web site: *www.takagi-usa.com.*

Trevor-Martin Corporation, 4151 112th Terrace North, Clearwater, FL 33762. Tel: (800) 875-1490 or (727) 573-1490; Fax: (727) 572-9350; Web site: *www.trevormartin-corp.com.*

William Zoeller, Consortium of Advanced Residential Buildings, 50 Washington Street, 6th Floor, Norwalk, CT 06854. E-mail: wzoeller@swinter.com.

*Pearls from Affordable Comfort

In late April, the annual Affordable Comfort conference attracted 1,371 attendees, a record number, to Minneapolis (see Figure 3). As usual, a renowned gathering of energy-efficiency experts presented workshops on a wide range of topics, including new construction, weatherization, and HVAC systems.

Many experts sprinkled their presentations with pithy statements, strong opinions, and wit. In a workshop called Wet, Stinky Basements, Terry Brennan, president of Camroden Associates in Westmoreland, New York, said, "What distinguishes a pond from a basement is a drain." Larry Palmiter, senior scientist at Ecotope in

See next page

why it's important to get the energy loads down before spending all this money on solar."

Unvented Cathedral Ceilings

Dean Talbott, program manager at Minnesota Power in Duluth: "A lot of builders have been installing unvented cathedral ceilings. We were told we could get away with it. I hope they can work, because there are a lot of them out there. But we have tested a few that have failed miserably. The people promoting these unvented hot roofs say that we know how to keep moisture out of the roof assembly, so if we build them carefully we can save energy and simplify the construction. But there are ways that moisture is getting into some of these roofs. One of them failed after eight or nine years. The builder pulled it apart, disposed of the rotten materials, and put it back together the same way it was built originally. A year later the homeowner called us in to look at it. We tested the roof with our moisture meter, and the sheathing was completely saturated. The point is, if there is any leakage this is a totally unforgiving assembly."

Joseph Lstiburek: "For an unvented insulated roof in a cold climate, you need to control the temperature of the condensing surface, so you need to add rigid insulation on top of the deck. The colder the climate, the more insulation you need. In Minnesota you need to add more than 50 percent of the roof R-value on top of the deck. An unvented cathedral ceiling insulated with dense-pack cellulose will only work, in my view, with thermal insulation on top of the deck, unless you have almost no moisture inside. If this system works for you, without the rigid insulation, you have been playing with fire and getting away with it. As soon as the interior moisture level gets above 30 percent, you will run into trouble."

Joseph Lstiburek: "You get some vapor diffusion through OSB or plywood and shingles, so you don't want to put Ice and Water Shield over the whole roof unless it is perfectly ventilated or insulated above the deck with rigid insulation."

Unvented Conditioned Attics

Joseph Lstiburek: "The more complicated the roof, the harder it is to vent. In heavy snow areas, if the building has a complicated roof, I always recommend building an unvented roof."

Joseph Lstiburek: "There are climatic limitations to the use of low-density spray foams like Icynene for unvented conditioned attics. In Minneapolis we are finding there is moisture accumulation at the Icynene/roof deck interface. Icynene should not be installed against a roof deck any farther north than Chicago or Boston. Further north, you need a vapor retarder over the Icynene if it is exposed—two layers of latex paint will work. But closed-cell foam works for this application everywhere."

For more information on the annual Affordable Comfort conference, contact Affordable Comfort, 32 Church Street, Suite 204, Waynesburg, PA 15370. Tel: (800) 344-4866 or (724) 627-5200; Fax: (724) 627-5226; Web site: *www.affordablecomfort.org*.

NEWS BRIEFS

SACRAMENTO, CA—The California State Senate has passed a bill (SB 1652) requiring that a percentage of new homes in developments of 25 homes or more include photovoltaic (PV) systems beginning in 2006. The percentage of homes that will be required to have PV systems has not yet been specified. The sponsor of the bill, Democratic Senator Kevin Murray, announced, "Solar power is much more cost-effective when included in the construction of new homes." In testimony opposing the bill, a representative of the California Building Industry Association expressed concern over the bill's cost to builders. The California Energy Commission estimates that installing a 2-kW PV system on a new home costs about $11,000. To become law, the bill requires the approval of Governor Schwarzenegger.

ATLANTA, GA—Scientists from the Georgia Tech Research Institute (GTRI) are studying the use of radar to detect mold behind gypsum wallboard. According to the researchers, mold emits a unique backscatter signature when exposed to millimeter-wave high-resolution radar. The researchers hope to develop a hand-held radar mold detector that might sell for $1,000 to $2,000. "We think this technology is on the cutting edge for detecting mold behind walls," says GTRI researcher Gene Greneker. For more information, visit *http://gtresearchnews.gatech.edu*.

MADISON, WI—As part of the US Department of Energy's Building America program, the Consortium of Advanced Residential Buildings (CARB) will be testing the performance of MemBrain, the smart vapor

RESEARCH AND IDEAS

The Right Way To Cathedralize An Attic

In a recent paper published in the *Journal of Building Physics*, Armin Rudd, an engineer with the Building Science Corporation of Westford, Massachusetts, summarized the results of his investigations into the performance of cathedralized attics. (An attic is "cathedralized" by moving the insulation from the attic floor to the rafter bays, thereby creating a conditioned space for attic HVAC equipment. For more information on cathedralized attics, see *EDU*, November 1997, September 1998, and October 2002.)

Rudd's paper identifies several potential pitfalls facing anyone building a cathedralized attic. He advises:

- In a cold climate, builders should avoid using a fibrous insulation that is permeable to air movement (see Figure 2).
- In a cold climate, builders using Icynene or similar low-density foams should include a vapor barrier.
- In a hot humid climate, builders should install a vapor-retarding roof underlayment under asphalt shingles.

Most Cathedralized Attics Work Well

Rudd's paper reports on field investigations and research projects in at least six states: California, Florida, Massachusetts, Minnesota, Texas, and Wisconsin. Most of the cathedralized attics he inspected performed well. For example, Rudd inspected two attics in Florida that had been cathedralized by spraying open-cell, low-density foam insulation on the underside of the plywood roof sheathing. He reports: "At the time of inspection, the roof sheathing showed no signs of moisture condensation, mold, discoloration, delamination, or deterioration. The roof sheathing and adjacent framing appeared as good as new. Wood moisture content reading ranged between 7% and 16% for the sheathing, with the median about 10%."

Indirectly Conditioned Attics

Most cathedralized attics are indirectly conditioned—that is, they lack a register supplying conditioned air from the furnace or air conditioner. However, even without direct conditioning, an attic that is capped with insulation is usually within a few degrees of the temperature of the conditioned space below. For example, monitoring equipment installed in the cathedralized attics of ten homes in Banning, California, showed that: "... During the cooling season the ... [attics were within] -2°F and +6°F of the living space, with the largest group between -2 and 0°F temperature difference. ... During the heating season, the ... [attics were] mostly between -2°F and +2°F of the living space, with the largest group between -2°F and 0°F temperature difference. These are small differences."

Rudd concluded, "The measured temperature conditions showed that the UC [unvented conditioned] attics were essentially at the same conditions as the actively conditioned space. This did not change with

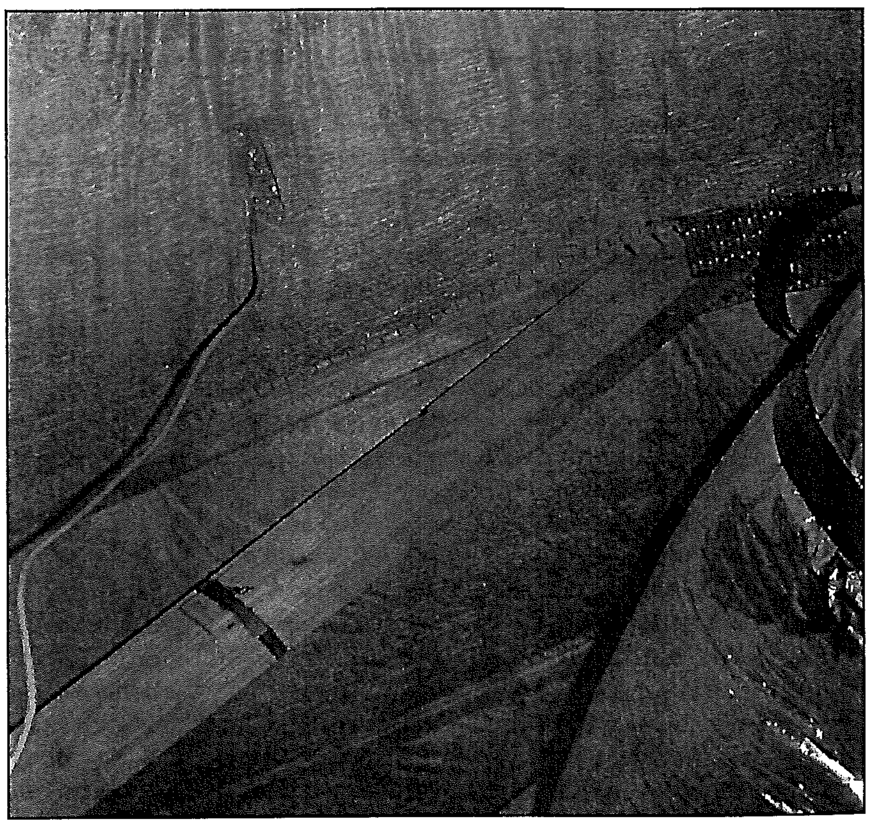


Figure 2. Air-permeable insulation, like this netted cellulose, should not be used to cathedralize an attic in a cold climate. The photo shows one of the roof assemblies in Phoenix, Arizona, studied by Armin Rudd; a HOBO temperature / relative humidity sensor is visible on one of the truss chords.

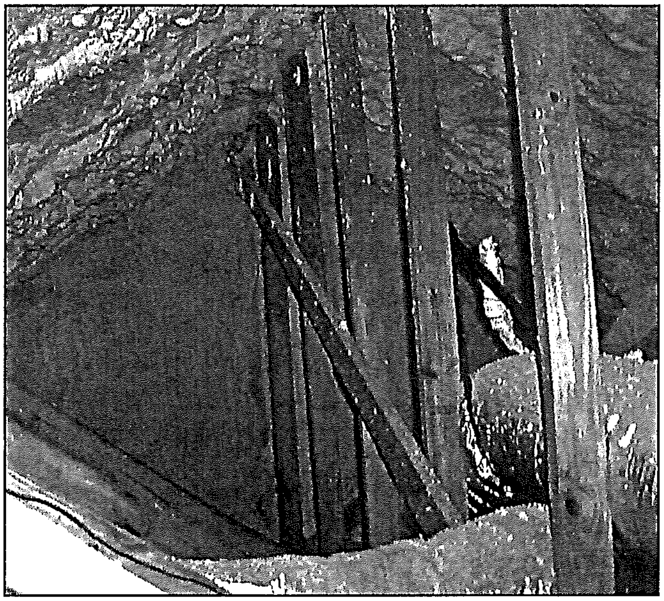


Figure 3. When Icynene is used to insulate a cathedralized attic in Florida, no vapor retarder is necessary. In cold climates, however, an interior vapor retarder is necessary to avoid possible moisture problems.

variation in the leakage and pressure differential test results. Hence, the current opinion is that the UC attic space behaves nearly the same as the actively conditioned space below it when it meets the leakage criteria for building enclosures with the attic access open."

Shingles Don't Get Too Hot

Rudd found that insulating the roof deck does not significantly increase the temperature of asphalt shingles. He wrote, "The summertime average daily temperature of roofing materials is nearly unchanged whether vented or unvented." For example, in Jacksonville, Florida, Rudd found, "on average over the whole month [August 2001], the UC attic shingles were 0.2°F warmer than those over the standard vented attic. These data represent the worst case—dark, gray-black, south-facing shingles."

Although some manufacturers of asphalt shingles may still dispute the issue, Rudd concludes: "Since the temperature of the roof shingles was shown not to be significantly affected by the presence of insulation it was unlikely to affect the durability of the shingles."

The Importance Of Stopping Air Movement

Because fiberglass insulation provides no barrier to air movement, Rudd recommends against using fiberglass batts in cathedralized attics, especially in cold climates. He writes, "The earliest form of UC attics used in residential construction employed polyurethane spray foam insulation adhered directly to the underside of the roof sheathing and gable end walls. This has been especially successful in hot humid regions to remedy moisture-related problems caused by the condensation of moist air on cool supply air ducts or on gypsum wallboard surfaces. ... The spray foam application inherently eliminates air movement, whereas the fibrous insulation applications [netted-and-blown cellulose or fiberglass batts] allow air movement which, depending on the sheathing temperature, can lead to moisture condensation under the roof sheathing."

In cold climates, fiberglass insulation will fail in this application unless rigid insulation is installed on top of the roof deck. Rudd advises, "If air-permeable insulation is used for UC attics in climates with roof sheathing temperatures that dip below 45°F for days at a time, then rigid insulation should be installed above the structural roof sheathing to keep the roof sheathing temperature above 45°F." Elsewhere, he writes, "When cold temperatures prevail for extended periods, it is doubly important to avoid moisture condensation on roof sheathing. Air-impermeable polyurethane spray foam applied continuously and directly to the underside of the roof sheathing and framing is preferred."

Icynene Problems

Although there have been sporadic reports of moisture problems in Icynene-insulated homes (see *EDU*, April 2005 and July 2005), there have been few published articles reporting measured moisture levels in Icynene-insulated wall or roof assemblies. Interestingly, Rudd's paper provides valuable data on moisture measurements in several cold-climate conditioned attics insulated with Icynene—or, as he refers to the insulation in his paper, "open-cell, semi-flexible, low-density foam with a published water vapor permeance of 16 imperial perm at 3 inches thickness." (In addition to Icynene, at least two other low-density foam products meet this description: BioBased 501 and Demilec Selection 500).

Rudd investigated six Icynene-insulated attics: four in Minnesota, one in Wisconsin, and one in Massachusetts (see Figure 3). He writes, "At all the sites investigated, at least one sample of the foam insulation was removed from within 5 feet of the roof peak. The location near the roof peak was chosen to reflect the worst case, since indoor air moisture conditions are most elevated at high points in roofs due to moisture buoyancy. ... In some cases ... indoor humidity was higher than normal. ... Considering the severe cold climate, the high humidity conditions, and the permeable open-cell foam insulation, it is understandable that the unsatisfactory

Table 1 — Moisture Measurement Results, Duluth, MN

Insulation Type	Insulation Thickness	Roof Orientation	House Interior Relative Humidity	Roof Sheathing Moisture Content Range
Open-cell foam	4" - 6"	South	44%	12% - 17%
Open-cell foam	3" - 5"	North	44%	Over 40%
Open-cell foam	5" - 8"	North	44%	Over 40%
Open-cell foam	5" - 7"	South	44%	12% - 16%

Table 1. At a Minnesota house with an Icynene-insulated cathedralized attic, the moisture content of the roof sheathing was over 40% in two locations. The house is located in a climate with 9,906 heating degree days. Other houses inspected by Rudd had lower roof sheathing moisture levels; at one house in Massachusetts, all readings were below 18% moisture content. The information in this table came from Table 7 in "Field Performance of Unvented Cathedralized (UC) Attics in the USA," by Armin Rudd.

wood moisture conditions were found at three out of the four houses inspected in Minnesota and Wisconsin. Despite this, there were no observations of fungal growth or wood deterioration."

Rudd's paper includes a table indicating that two areas on the north roof of one of the Minnesota homes had sheathing with a moisture content over 40% (see Table 1, page 10). At another Minnesota home, three areas on the north roof had sheathing with a moisture content between 25% and 28%. At a third Minnesota home, one area on the north roof had sheathing with a moisture content between 20% and 25%. Finally, at the Wisconsin home, two areas of the roof had sheathing with a moisture content above 40%. These moisture measurements provide a strong argument in favor of the installation of a vapor retarder in cold-climate Icynene-insulated homes.

Solar Vapor Drive Through Shingles?

Rudd was one of the first investigators to identify the problem of solar vapor drive through asphalt shingle roofs (see *EDU*, January 2003). In his paper, Rudd describes observations he made in a cathedralized attic insulated with netted cellulose insulation in Houston, Texas: "It became apparent that solar-driven moisture through composition shingles was a significant factor to be accounted for. When roof temperatures fall below the dew point because of night sky radiation, moisture condenses on the top surface of the roof. Thus, in the morning, the roofs are generally wet. Some of this moisture is drawn into the material and between the laps of the shingles. Solar radiation subsequently heats the roof surface and drives water vapor into the roof assembly. ... The solar-powered vapor drive peaks at about noontime. ... While the space conditioning system (cooling plus dehumidification) can remove this moisture, it is prudent to eliminate the moisture load by installing a vapor retarding roof underlayment beneath the composition shingles." Elsewhere, Rudd notes that water vapor can be driven into the roof assembly "whether the roof is vented or not."

Ping-Pong Moisture

Rudd's recommendation that asphalt-shingled houses with cathedralized attics in hot humid climates include low-permeance roofing underlayment has been incorporated into the International Energy Conservation Code (see *EDU*, June 2003). In a conversation with *EDU*, however, Rudd noted that recent data have raised new questions concerning solar vapor drive through shingles. "In Houston, we saw that moisture flow, but we weren't able to measure the quantity," said Rudd. "We were getting really high dew points when the sun came out, but then by end of day the plywood was very dry. Later, moisture would find its way back up to that really dry wood. We thought it was wise to recommend the use of low-perm underlayment."

Later, Rudd was surprised to discover that the same phenomenon that he observed in humid Houston was also occurring in Phoenix, where asphalt shingles are rarely wet. "At this point we are not really sure what's going on. We've seen the same phenomenon in vented and unvented roof assemblies, in both humid and dry climates. We're not saying that we were wrong that moisture is coming through the shingles, but at this point we're not sure you need to go through the expense of installing low-perm underlayment. Actually we have never been able to quantify the amount of moisture that is coming through the roof. We see the moisture pulse, and we believe that some amount of moisture is coming through, but when all is said and done, we don't really have proof of the quantity of moisture that comes through the roof. That is still not known."

According to Rudd, the daily moisture pulse may represent a quantity of water bouncing in and out of the roof sheathing: "Additional testing has shown us that the moisture pulse—what we thought was a significant moisture pulse—it turns out that a lot of that is moisture that is absorbed and desorbed every day from the roof sheathing. I've heard John Straube call it 'ping-pong moisture.'"

Reached by phone, John Straube, an assistant professor of civil engineering at the University of Waterloo, gave credit to John Timusk for coining the term "ping-pong moisture." Straube agreed with Rudd that the source of the moisture pulse observed in some roof assemblies remains unknown. "Somehow, the moisture must be getting recharged periodically," said Straube. "Otherwise the moisture level would dwindle over time. It isn't clear that it is exterior moisture—it could be interior moisture that gets dragged back into the roof assembly every night." Until further research pins down the source of the moisture, Straube agrees with Rudd that builders installing cathedralized attics in hot humid climates should stick with low-permeance roofing underlayment.

"Field Performance of Unvented Cathedralized (UC) Attics in the USA," by Armin Rudd, was published in the October 2005 issue of the *Journal of Building Physics*. For more information, contact Armin Rudd, 726 Maple Street, Annville, PA 17003; E-mail: arudd@buildingscience.com.

INFORMATION RESOURCES

Ecohouse 2

Sue Roaf, an architecture professor at Oxford Brookes University in England, has produced a second edition of *Ecohouse*, her 2001 book on residential green building (see Figure 4). Revised with the help of her two co-authors, Manuel Fuentes and Stephanie Thomas, the new edition, *Ecohouse 2*, is subtitled "A Design Guide." The book, though flawed, is a valuable introduction to green building principles.

One of the houses profiled in *Ecohouse 2* is Roaf's own house. Built in 1995 at a cost of $116 per square foot, Roaf's home includes triple-glazed windows, a 4-kW photovoltaic (PV) system, and 54 square feet of solar thermal collectors. Because Roaf has a deep-green perspective—at one point Roaf writes that "'modern buildings' are literally destroying the planet"—the book favors traditional over innovative building practices.

Design Guidance

For the most part, *Ecohouse 2* lives up to its billing as a design guide. The book provides advice on insulation thickness, thermal mass, ventilation, rock-bed volume, and solar collector sizing:

- "Within the UK, as a rule of thumb, 150 mm [6 inches] of insulation in walls, 250 mm [10 inches] in roofs and, say, 100 mm [4 inches] expanded polystyrene under a concrete ground floor are considered to result in a 'superinsulated' house."
- "A simple rule of thumb to use when sizing mass in a very passive building, designed to minimize heating and cooling loads, is that the optimal depth of mass for diurnal use is 100 mm [4 inches] for each exposed surface."
- "For a well-designed house ... most problems of air quality will disappear when the air change rate is 0.2 air changes per hour. ... Humidity control can be achieved with a rate of 0.3 air changes per hour or more."
- "The rock bed volume should be 0.6 cubic meters per

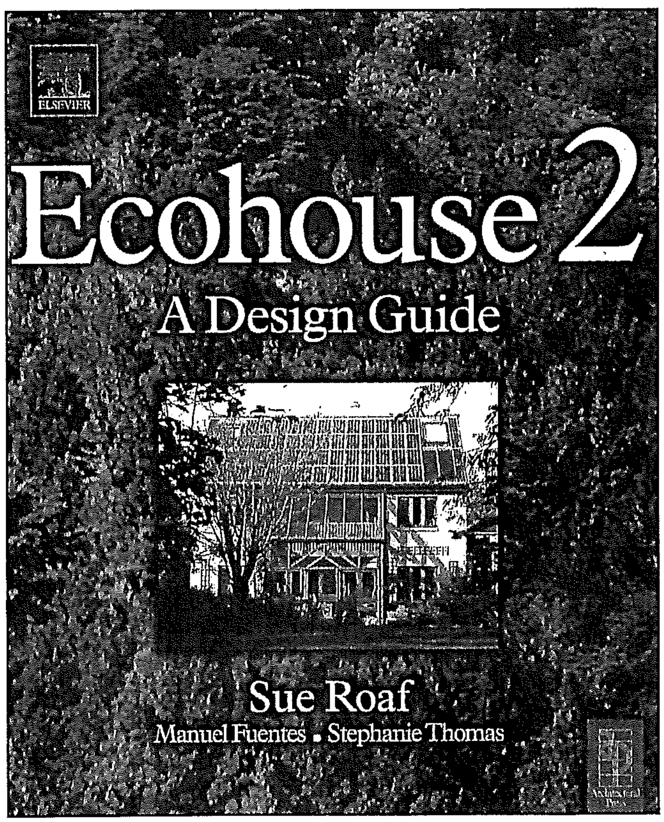
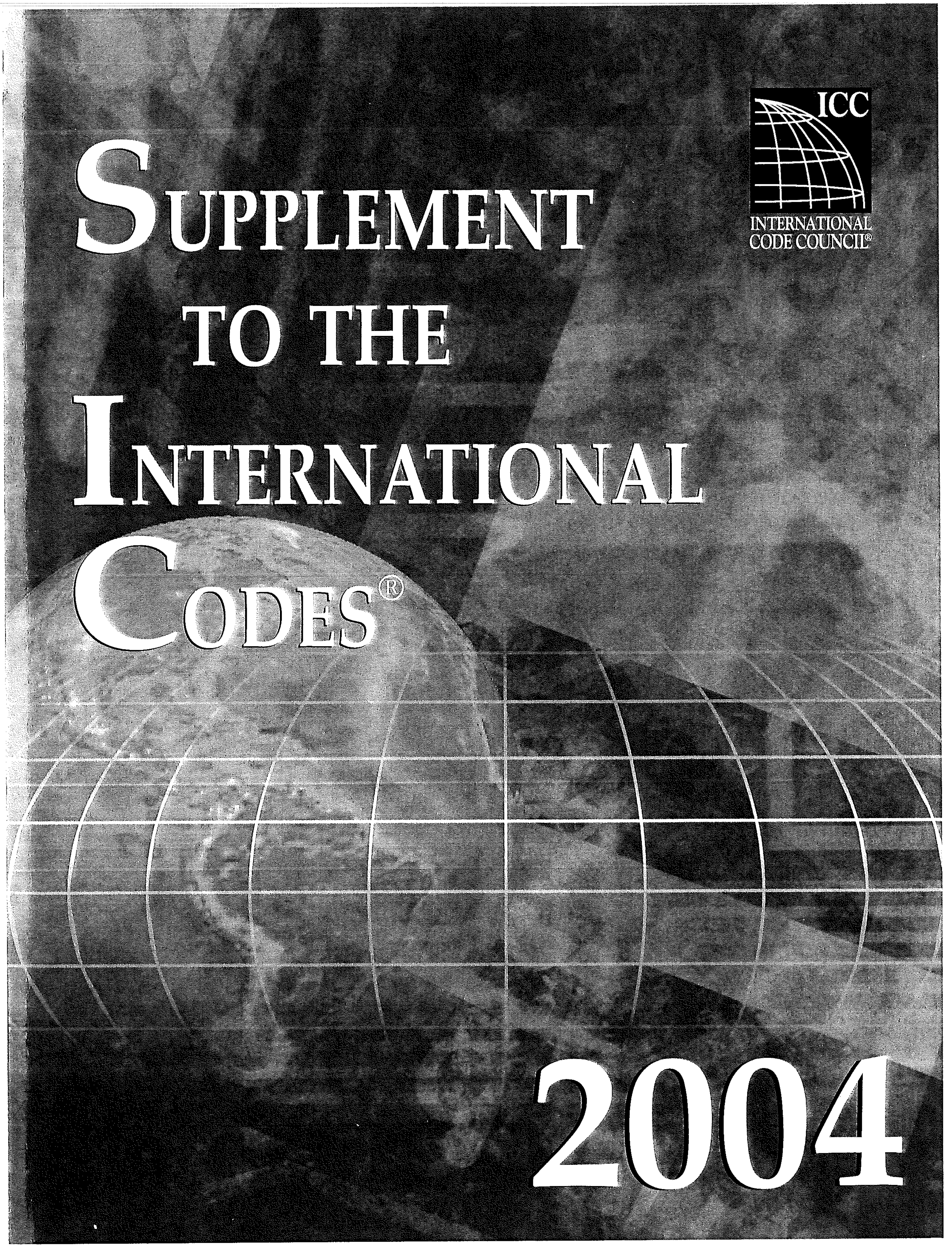


Figure 4. Sue Roaf's *Ecohouse 2: A Design Guide* is an introduction to green residential construction.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beyond all edges of the hole. The Steel patch shall be fastened to the web with No. 8 screws (minimum) spaced no greater than 1 inch (25.4 mm) center-to-center along the edges of the patch, with a minimum edge distance of 0.5 inch (12.7 mm).

Section R804.3.6.1 Add new section as shown: (RB156-03/04)

R804.3.6.1 Holes exceeding limits. Where the depth of the hole exceeds 70% of the depth of the web or width of the hole exceeds 10 inches, the framing member shall be replaced or shall be re-designed in accordance with accepted engineering practice by a registered design professional.

Section R806.2 Change to read as shown: (RB231-03/04)

R806.2 Minimum area. The total net free ventilating area shall not be less than 1/150 of the area of the space ventilated except that the total area is permitted to be reduced to 1/300, provided that at least 50 percent and not more than 80 percent of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least 3 feet (914 mm) above the eave or cornice vents with the balance of the required ventilation provided by eave or cornice vents. As an alternative, the net free cross-ventilation area may be reduced to 1/300 when a vapor barrier having a transmission rate not exceeding 1 perm (57.4 mg/s.m^2.Pa) is installed on the warm-in-winter side of the ceiling.

Section R806.4 Add new section as shown: (EC48-03/04)

R806.4 Conditioned attic assemblies: Unvented conditioned attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) are permitted under the following conditions:

1. No interior vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly.
2. An air-impermeable insulation is applied in direct contact to the underside/interior of the structural roof deck. "Air-impermeable" shall be defined by ASTM E 283.

   Exception: In zones 2B and 3B, insulation is not required to be air impermeable.

3. In the warm humid locations as defined in Section N1101.2.1:
   a. For asphalt roofing shingles: A 1-perm (57.4 mg/s · m^2 · Pa) or less vapor retarder (determined using Procedure B of ASTM E 96) is placed to the exterior of the structural roof deck; i.e., just above the roof structural sheathing.
   b. For wood shingles and shakes: a minimum continuous 1/4-inch (6 mm) vented air space separates the shingles/shakes and the roofing felt placed over the structural sheathing.
4. In zones 3 through 8 as defined in Section N1101.2, sufficient insulation is installed to maintain the monthly average temperature of the condensing surface above 45°F (7°C). The condensing surface is defined as either the structural roof deck or the interior surface of an air-impermeable insulation applied in direct contact to the underside/interior of the structural roof deck. "Air-impermeable" is quantitatively defined by ASTM E 283. For calculation purposes, an interior temperature of 68°F (20° C) is assumed. The exterior temperature is assumed to be the monthly average outside temperature.

Section R808.1 Change to read as shown: (EC48-03/04; EL3-03/04)

R808.1 Combustible insulation. Combustible insulation shall be separated a minimum of 3 inches (76 mm) from recessed luminaires, fan motors and other heat-producing devices.

> **Exception:** Where heat-producing devices are listed for lesser clearances, combustible insulation complying with the listing requirements shall be separated in accordance with the conditions stipulated in the listing.
>
> Recessed luminaires installed in the building thermal envelope shall meet the requirements of Section N1102.4.3.

CHAPTER 9
ROOF ASSEMBLIES

Section R905.1 Change to read as shown: (RB233-03/04)

R905.1 Roof covering application. Roof coverings shall be applied in accordance with the applicable provisions of this section and the manufacturer's installation instructions. Unless otherwise specified in this section, roof coverings shall be installed to resist the component and cladding loads specified in Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3).

TECHNICAL BULLETIN

FOAM ENTERPRISES LLC

This will confirm Elk premium roofing products have been approved for use with polyurethane spray-in-place foam manufactured by Foam Enterprises, LLC since September 9, 2003 and carry the full limited warranty provided the installation requirements are followed.

- **FE 100, FE 110, FE 3031.7 (effective 9/9/03)**
- **FE 148, FE 158, and FE 168 (effective 5/26/05)**

INSTALLATION REQUIREMENTS

1. All structural roof work including decking/sheathing is in place and in compliance with local codes.

2. The spray-in-place foam is applied in accordance with the manufacturer's specifications and guidelines to the underside of the roof decking/sheathing and complies with local codes.

3. Apply Elk starter strip, Elk hip and ridge shingles, and Elk field shingles in accordance with the recommendations printed on each bundle wrapper. Elk hip and ridge shingles will carry the limited warranty period applicable to the Elk field shingles.

4. Elk will not be responsible for any deficiencies or movement of the roof deck, manufacturing defects in the fasteners resulting in their failure to perform, and/or improper application of the substrate or Elk fiberglass shingles.

5. It is the responsibility of the design professional to examine the need for structural ventilation and to ensure interior air quality. For any building, construction must be in compliance with local codes.

For our product specifications, limited warranties, or other information regarding Elk premium building products, please contact the Elk location nearest you or visit our web site at www.elkcorp.com.

For information regarding the Foam Enterprises products please call 800-888-3342 or visit their web site at www.foamenterprises.com.

TBSD-020 R1 12/19/05

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6200 Zerker Rd.
Shafter, CA 93263
1-800-355-4968

P.O. Box 228
Myerstown, PA 17067
1-800-944-4344

TECHNICAL BULLETIN

COMFORT FOAM

This will confirm Elk premium roofing products have been approved for use with polyurethane spray-in-place foam manufactured by Comfort Foam since March 16, 2000 and carry the full limited warranty provided the installation requirements are followed.

- **CF 100, CF 110, and CF 300 (effective 3/16/00)**
- **CF 148, CF 158, and CF 168 (effective 5/26/05)**

INSTALLATION REQUIREMENTS

1. All structural roof work including decking/sheathing is in place and in compliance with local codes.

2. The spray-in-place foam is applied in accordance with the manufacturer's specifications and guidelines to the underside of the roof decking/sheathing and complies with local codes.

3. Apply Elk starter strip, Elk hip and ridge shingles, and Elk field shingles in accordance with the recommendations printed on each bundle wrapper. Elk hip and ridge shingles will carry the limited warranty period applicable to the Elk field shingles.

4. The Elk Corporation will not be responsible for any deficiencies or movement of the roof deck, manufacturing defects in the fasteners resulting in their failure to perform, and/or improper application of the substrate or Elk fiberglass shingles.

5. It is the responsibility of the design professional to examine the need for structural ventilation and to ensure interior air quality. For any building, construction must be in compliance with local codes.

For our product specifications, limited warranties, or other information regarding Elk premium building products, please contact the Elk location nearest you or visit our web site at www.elkcorp.com.

For information regarding the Comfort Foam products, please call 800-888-3342 or visit their web site at www.comfortfoam.com.

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TECHNICAL CertainTeed BULLETIN

FIBER GLASS SHINGLES APPLIED OVER UNVENTILATED/INSULATED ROOF DECKS

No. R-201B **Date Issued:** 10/8/2004 ***Supersedes:*** *R-201A, 2/15/2001*

CertainTeed's Limited Asphalt Shingle Warranty, including SureStart^{TM} coverage, will remain in force when its fiber glass asphalt shingles manufactured to meet ASTM D3462 are applied to roof deck assemblies (slopes $\geq$ 2:12) where foam insulation is prefabricated into the roof deck system (often called "nailboard insulation"), where insulation is installed beneath an acceptable roof deck system, or where radiant barriers are installed, with or without ventilation directly below the deck. ***See important restrictions below.***

- Acceptable roof deck surfaces must consist of either minimum 3/8" thick plywood or minimum 7/16" thick OSB. If an alternate deck surface material is being considered, then please contact CertainTeed at the number below.

- The design professional is responsible for ensuring 1) proper quality and application of the insulation and/or radiant barrier, 2) provision of adequate structural ventilation and/or vapor retarders as determined to be necessary, and 3) that all local codes are met (particularly taking into account local climate conditions). Special attention must be taken if cellular foam, fiber-glass, or cellulose insulations, or other highly-permeable insulation will be used in an unventilated system, or if the insulation/rafter or insulation/joist planes may create an air leak that could lead to moisture transmission and condensation problems. *All these important factors and decisions, while not the responsibility of CertainTeed Corporation, are critical to assure proper deck system performance.*

- CertainTeed shall not have any liability or responsibility under its warranty for
  a) Damage to or defects in its shingles caused by settlement, movement, distortion, deterioration, cracking, or other failure of the roof deck or of the materials used as a roofing base over which its shingles are applied,
  b) Damage caused by the growth of mold or mildew, or
  c) Defects, damage, or failure caused by application of its shingles not in strict adherence with CertainTeed's written instructions.

Roofing Systems Technical Service

CertainTeed Corporation
Roofing Products Group
1400 Union Meeting Road; P.O. Box 1100
Blue Bell, PA 19422
800-345-1145

Qualified Shingle Manufacturers

In regards to residential steep-slope roofing products and shingle manufacturers, there are specific companies that have no implication of exclusions from warranty coverage. This table is a list of all approved asphalt shingle manufacturers with warranties that are **not** affected from the following exclusions listed in the *2001-2003 Residential Steep-Slope Roofing Materials Guide* by the National Roofing Contractors Association:

- Defects in, failure or improper application of, roof insulation, roof deck, or any other underlying surface of material used as a base over which the shingles are applied.
- Application of shingles directly to insulation or an insulating deck without manufacturer's prior approval.

**Please note some companies may have one of the two above exclusions listed. They have been noted in italics following the company name.*

Company Name	Products Covered
Atlas Roofing Corporation	StormMaster LM, StormMaster ST, Pinnacle 40, Pinnacle 30, GlassMaster 25, GlassMaster 25 Alpine, GlassMaster 25 Matterhorn, GlassMaster 20, GlassMaster T-LOK, Chalet, Stratford, Legend, WeatherMaster ST, WeatherMaster 20, WeatherMaster T-LOK, and MOD 90 MSR
CertainTeed Corporation **This manufacturer still applies the first of the two above listed exclusions.*	Grand Manor Shangle, Carriage House Shangle, Presidential TL, Landmark TL, Presidential Shake (and AR), Independence Shangle (and AR), Landmark 40 (and AR), Halteras, Woodscape 40, Hallmark Shangle, Landmark 30 (and AR), Custom Sealdon 30, XT 30 (and AR), Woodscape 30, Landmark 25 (and AR), Classic Horizon Shangle, New Horizon Shangle, Hearthstead, Custom Lok 25, XT 25 (and AR), Sealdon 25, Woodscape 25, Firehalt (and AR), Seal King 25, Jet 25, CT 20 (and AR), Firescreen
Elk Corporation of Alabama or Elk Corporation of Texas	Elk Ridge Crest Vented High Profile Ridge, Ridgecrest High Profile Hip & Ridge, Seal-A-Ridge with formula FLX, Z ridge and other Elk Hip and Ridge Shingles, Prestique Plus 40, Prestique Plus 40 with StainGuard, Prestique Gallery Collection, Prestique Gallery Collection with StainGaurd, Prestique 1 35, Prestique 1 35 with StainGuard, Prestique 30, Prestique 30 with StainGuard, Prestique 30-MD, Prestique 30-MD with StainGuard, Prestique 25 Raised Profile, Prestique 25 Raised Profile with StainGuard, Ridgecrest vented high Profile ridge, Z Ridge, Seal-A-Ridge with Formula FLX

Company Name	Products Covered
Elk Corporation of Alabama	Capstone 40, Capstone 40 with StainGuard
Georgia Pacific Corporation	Summit III, Summit, Tough-Glass Plus, Tough-Glass, Tough-Glass T-Lock, Premium-25, Aspalt-20, Savannah
GAF Materials Corporation **This manufacturer applies the second of the two above listed exclusions. You must call for prior approval - 800-ROOF-411.*	Royal Sovereign, Marquis WeatherMax, Timberline 25, Original Timberline, Timberline Ultra, Slateline, Grand Sequoia, Grand Canyon, Country Mansion, Country Estates: all GAF Weather Stopper products, Sentinel
Herbert Malarkey Roofing Company **This manufacturer still applies the first of the two above listed exclusions.*	Type 202, Dura Seal-20, Type 204 Dura Seal-25, Type 230 Alaskan
IKO Manufacturing Inc.	Chateau, Crowne 30, Cambridge 25, Cambridge 30, Cambridge, 40 AR, Renaissance XL, Aristocrat 25, Imperial Gentry 25, Royal Victorian, Skyline 25, Cathedral XL, Imperial Seal 20, Imperial Glass 20, Regency Marathon 20, 25, 30: ArmourLock 20, Ultra 25
Owens Corning **This manufacturer still applies the first of the two above listed exclusions.*	Oakridge 40 Deep Shadow (AR), Oakridge 40 AR Deep Shadow, Oakridge 30 Shadow, Oakridge 30 AR Shadow, Oakridge 25, Oakridge 25 AR, Prominence & AR Supreme, Supreme 30, Supreme, Supreme AR Glaslock, Classic & AR, Glaslock
PABCO Roofing Products, a Division of Pacific Coast Building Products, Inc. **This manufacturer still applies the first of the two above listed exclusions.*	Premier Advantage, SG-25/3M Algae Block, GC-20, Premier-40, Premier 30/3M Algae Block, Premier-25, Premier-25/3M Algae Block
Tamko Roofing Products, Inc. **This manufacturer still applies the first of the two above listed exclusions.*	Heritage 40 AR, Heritage 40, Heritage 30 AR, Heritage 25 AR, Elite Glass-Seal AR, Glass-Seal AR, Heritage 40, Heritage 30, Heritage 25, Elite Glass-Seal, Elite Glass-Seal AR, Glass-Seal, Glass-Seal, Tam-Loc Glass, Organic Seal-Down 25, Heritage M40, Heritage M30, Heritage M25