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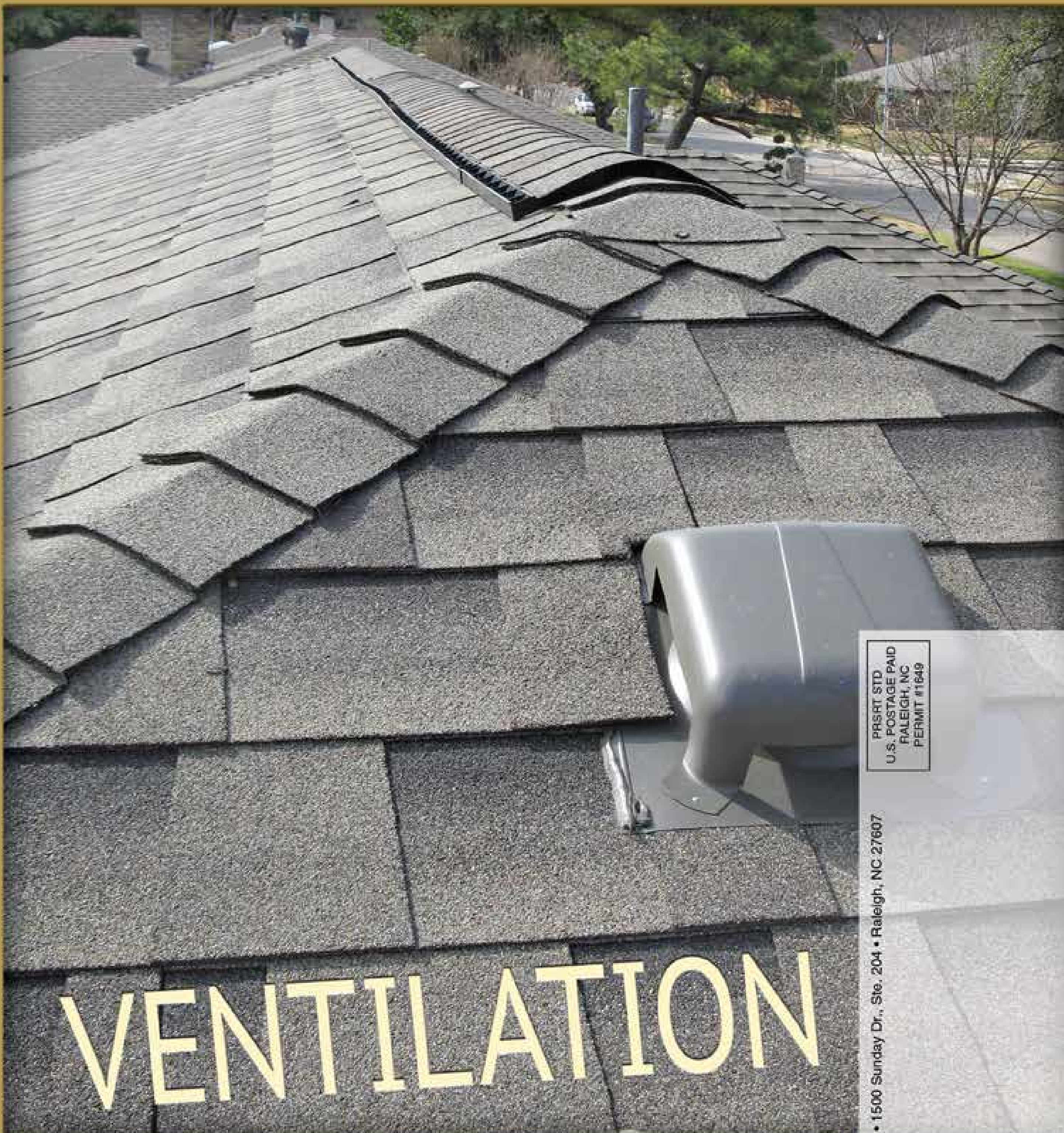

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RCI was chartered, in part, to bridge the gap between the seemingly disparate elements of the roofing profession. It later expanded to include issues of waterproofing and of the entire building envelope. The goal of *Interface* is to connect these elements, educate and inform about related topics, establish a common ground for discussion, promote Association programs, and reach out to the industry at large. The articles contained in this publication are intended to provide information that may be useful to readers of *Interface*. RCI does not necessarily endorse this information. The reader must evaluate the information in light of the unique circumstances of any particular situation and independently determine its applicability.

FEATURES

SPECIAL INTEREST

DEPARTMENTS

In This Issue: We explore issues of ventilation, including the net free area of a roof, water entry through attic vents, and condensation caused by "cool" roof systems.

On the Cover: Ridge vents on an asphalt-shingled roof in Texas. Courtesy All-Pro Roofing.

Arthur P. "Chip" Ward, RRC
President

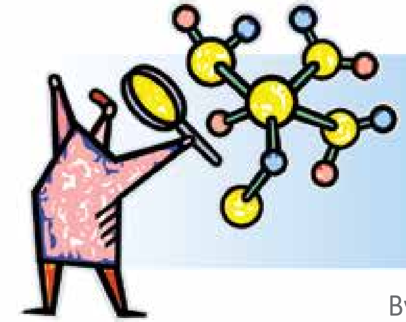
It's Been a GOOD YEAR

This is my last President's Message during my term as president of RCI, Inc. It has been a good year with a lot of accomplishments that I feel have helped our organization grow and prosper. These accomplishments include:

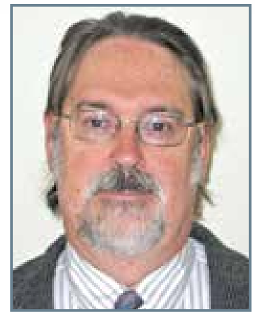
- RCI issued a Position Statement on Procurement in June 2012 that was well received by the roofing industry and long overdue. In July 2012, I followed that up by testifying on the subject before the Texas House of Representatives Government Efficiency & Reform Committee on Purchasing Cooperatives and Inter-Local Agreements. It was quite an experience, and from comments heard after the committee meeting, we made some inroads in presenting a number of points for discussion as possible recommendations by the committee to the legislature in the upcoming legislative session this year.
- The new Strategic Plan was introduced a year ago in March 2012, and the current Board of Directors is actively working to implement the plan.
- In my first Board meeting after the 2012 convention, I formed the Task Force on Governance to review and make recommendations concerning representation on the RCI Board of Directors and to determine what, if any, realignment or changes are warranted. As of this writing, the task force appears to be finalizing its recommendations to be presented to the Board at the RCI, Inc. 2013 convention this month.
- RCI's standard Request for Qualifications (RFQ) form has been completed and put on the RCI website, but it is still under review for some modifications.
- The RRO exam has been rewritten and will be given at the convention for the first time.
- The Stucco & Exterior Finish & Cladding course has been completed.
- The Vegetative Roof course has been completed.
- The Registered Exterior Wall Observer exam is scheduled to be drafted sometime in 2014, with possible delivery in 2015.
- We added additional office space to the RCI, Inc. home office in Raleigh, NC, and refurbished the existing office spaces this year. In the new space, the William Correll Library was created, honoring our first executive director of RCI.

I would like to thank the Board of Directors for its support over the past year; James R. Birdsong, executive vice president and CEO of RCI; and the great RCI staff for their help in making this a super year. They guided me and supported me through the year and appear to have kept me out of trouble.

I sincerely thank everyone, and look forward to seeing you at the convention. Bring your flowered shirt and dancing shoes.



Basic Research NEEDED



By Dr. Richard E. Norris, RRC, PE

Basic research is essential to our success as building envelope consultants. The requirements for our materials and systems are changing, and we must understand the new materials in order to use them intelligently.

Our ability to determine which roofing and waterproofing materials will work reliably for the decades for which we design our roofing and waterproofing systems depends upon knowing the basic physical and chemical properties of the materials and how they perform in service. What do we know about them? In recent years, there has been almost no basic research on the materials we use.

We are asking more of building envelope materials and systems than we did just a few years ago. We expect them to last longer, and we employ them such that there is less air movement across the assembly. How do we know that all of the materials will last under these conditions? What changes do we make to building physics to meet today's design requirements, and how do these changes affect the performance of the building envelope systems?

The accumulation of condensed moisture under cool roofs is one such issue. To understand it, we need to know some basic physical properties of the materials in the roof assembly: density, porosity, thermal conductivity, permeability, etc. If we understand these properties, we can model the systems and predict whether they will cause the building to "self compost." This is particularly crucial when we replace a "hot" roof with a new "cool" roof.

Researchers at Oak Ridge National Laboratory (ORNL) are building an extensive database of materials for the WUFI (Wärme und Feuchte instationär, translated as transient heat and moisture) program. This will allow us to analyze the system at the design stage, before installation. It will help us to know how much insulation to install, where to install it, and whether or not to ventilate. The airflow in the attic space is not yet well understood. Researchers are working on this. Forced ventilation can be modeled in WUFI, but passive ventilation modeling is difficult, at best.

The best way to know how long a material will last in a particular assembly, in a particular environment, and at a particular location is to build it and watch it. But we seldom can wait 15 years or longer to see if the new material will actually last in service. So we must make some assumptions based upon our experience with similar materials in past assemblies. Unfortunately for us, this offers only limited assurance of a new product's performance; and every time the manufacturer changes the formula, we have a new product.

Some changes in products are forced upon the manufacturers by government and/or environmental legislation. The reduction in volatile organic compounds (VOCs) is one example. Another is the trend to utilize reflective (cool) roof surface materials. Still another is the change to alternative pressure-preservative chemicals for wood. When the new pressure-preservative chemicals first came on the market, we did not know that they would cause rapid corrosion of the fasteners we use to secure the wood to the framing. We are starting to see similar failures due to the accumulation of condensation.

What are we to do? Not every consultant has a chemist and an engineer on staff, as well as a testing laboratory. If we did, we would have difficulty convincing our clients to pay for the time and expertise to test and analyze the new materials.

Can we rely upon the manufacturers of the new materials to tell us what their materials can do? My experience is that they either do not know the material properties we need in order to run WUFI, or they will not share them with designers if they do know them. I am sure that they do not know how long their new materials will last in service, either. We do not have a reliable, generally accepted accelerated weathering test for building envelope materials.

When I entered academia, this was to have been my life's work. Unfortunately, I was unable to find funding for my research and lost my faculty job for lack of research publications. The basic research in this area would include development of test methods to quantify and model the mechanical behavior of materials. Then, the change in mechanical behavior (and chemical composition!) during aging could be measured. This would allow comparison of changes in service with those in accelerated weathering tests, permitting us to predict how long new materials should last in service.

We need an investment in basic research to enable us to analyze new materials and make informed decisions about their probable performance and durability in service.

Richard Norris is owner of Norris Consulting Services, Fremont, CA, and a Professional member of RCI. He is a registered engineer and an RRC, and holds a doctorate from the University of California at Berkeley.

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MEASURING NET FREE AREA OF ROOF SYSTEMS

By William B. Rose

What is the net free area of a roof on an existing house? The answer to that question seems to come up maybe twice in the life of a building: It comes up at design time, and it comes up if someone notices a problem—lack of ventilation is often seen as the default culprit. The late Tony Woods showed his Canadian roofing contractors that they could make more money than their U.S. counterparts by providing ceiling air tightening and insulation as an add-on to a roofing job, rather than roof ventilation. And those attic assemblies delivered far better energy performance than the holes-in-the-roof approach common in the U.S.

I've never seen someone try to do that calculation by measuring all openings with calipers and applying resistance factors for screens and for hole shapes and sizes. Thanks to weatherization and energy retrofit contracting (ERC) of existing homes, the matter of attic assessment has taken on new life with new tools. ERC specializes in providing added airtightness to ceilings and adding insulation in attics. These two strategies, especially taken together, provide greatly improved energy performance of attics; improved ice-dam performance; and, judging from anecdotes, few or no complaints about moisture performance. This is good.

Thanks to the efforts of researchers like Michael Blasnik, Anthony Cox, and Collin Olson, we can actually measure the net free opening area of a roof and of a ceiling. The key is making effective use of the blower door, with zone pressure measurements. Here's how to do it:

1. Set up and run the blower door, creating pressurization or depressurization of a fixed amount—say, 50 pascals (Pa).
2. Do a zone pressure measurement in the attic to find the pressure difference, with the blower door running, between the attic space and the outdoors.
3. Add a hole in the ceiling, for example by opening the attic hatch, and get a second flow measurement and a second zone pressure measurement.
4. Calculate.

Figure 1 is a schematic showing the measurement sites and resistors to flow at the locations of the ceiling, the new hole, the

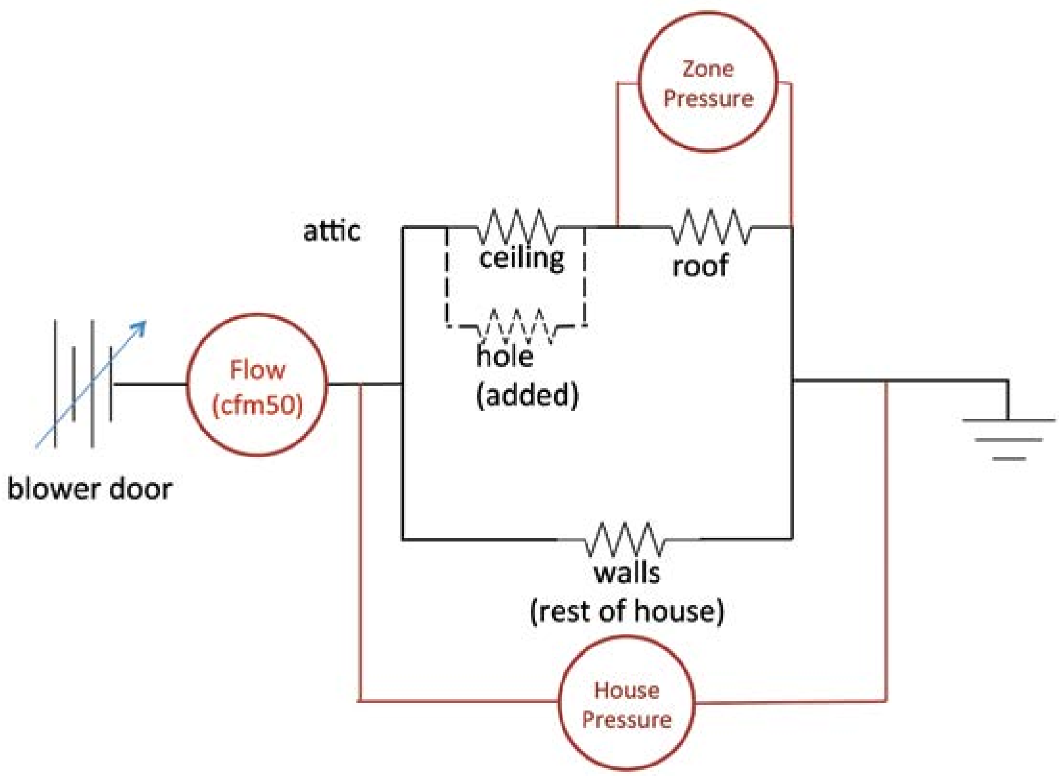


Figure 1 – Schematic showing a blower door test as an electric circuit analogy. Zone pressure in the attic is shown with reference to outdoors.

A Legacy Practice That Needs Revisitation?

When searching for articles to fill this month's issue on ventilation, I remembered a presentation by William Rose at a Region I meeting in 2000. His talk was called the "Early History of Attic Ventilation" (*docserver.nrca.net/technical/7877.pdf*) and came to the conclusion that the 1/300 ventilation ratio was apparently derived from a single data point in a single 1938 study by Rowley. It became an industry standard. Though venting was originally intended to be a means of "condensation control," it eventually became a requirement of shingle manufacturers to prevent premature degradation of their products. This article brings focus to sealing the building's conditioned space from the attic rather than relying on ventilation to remove moisture.

Since I have been conditioned to believe that venting the roof deck is necessary for the longevity of shingles, I raised this point in an e-mail exchange with Mr. Rose. He pointed out that the shingle industry didn't require deck ventilation "until the early 1980s, when the industry was adjusting to unfamiliar raw materials from new and different sources, such as Alaska."

In one e-mail, he wrote (and I paraphrase), "Ventilation industry says: Vent roofs with our shingles or they'll get too hot. Response: How hot is too hot? Ventilation industry: [silence]. It appears that vented black shingles in Phoenix are warrantable; unvented white shingles in Minneapolis are not. This stance cannot be taken seriously."

Well, *Interface* readers? I would be interested in other evidence and opinions on the subject. Mr. Rose believes that, as consultants and professionals, our underlying ethic should be to benefit our clients more than ourselves. By requiring attic ventilation to obtain shingle warranties when the ability of ventilation to affect shingle temperature is weak compared to, say, shingle color, we may be covering ourselves more than benefitting our clients. Precision (1/300) attic ventilation is a legacy practice outlook and one that is deserving of a new critical assessment.

Rick Wagner, RRC, CCS
Chairman, *Interface* Peer Review Board

roof, and the rest of the house. The calculation is quite simple:

$$A_r = \left[\frac{(F_2 - F_1)}{10}\right] / \left[\left(\frac{ZP_2}{50}\right)^n - \left(\frac{ZP_1}{50}\right)^n\right]$$

Where:

- A_r is the net free area of the roof openings (in.^{2}).
- F_2 and F_1 are the measured blower door flows of tests 2 and 1 (cfm@ 50Pa).
- ZP_2 and ZP_1 are the measured zone pressures with respect to outdoors of tests 2 and 1 (Pa).
- n is the flow exponent, usually 0.65.

The assumptions in this relation are:

1. A change of 10 cfm50 flow occurs with a change of 1 in.^{2} of hole opening area.
2. Both blower door tests were conducted at 50 Pa.

So what do we do with this new-found ability?

The first thing we will note is that there are essentially no 1/300-vented and no unvented roof assemblies out there. That distinction is artificial and is not represented in the actual building stock. Every roof assembly, whatever we choose to call it, is partially vented and partially unvented. It has leaks from the house to the attic and leaks from the attic to outdoors. We can assign two leakage numbers to any attic assembly. This includes full attics, cathedral ceilings, and story-and-a-half knee wall areas. Different unconnected zones will have different leakage values. If shingle warranties strictly required 1/300 attic ventilation, I suspect we would find few complying attics.

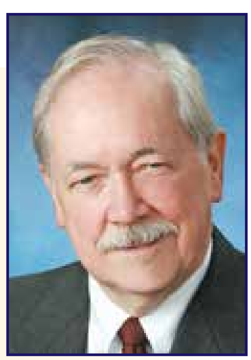
The second thing we may do as roof consultants is to build up a database of attic values and see what leakage numbers correspond to good performance and which ones correspond to bad performance. If your experience is like mine, leakage across the ceiling plays a much bigger role than opening area in the roof. Tony Woods was very much on the right path.

The third thing we may do is put these numbers to use. From experience and the use of our database, we can distinguish attics that are performing well, and we can make better predictions when designing or redesigning roofs.

Attic venting is a legacy practice, a leftover from the days when ceilings were simply leaky and remained leaky. Every roof consultant I know views the 1/300 rule skeptically, despite the fact that it appears in the code as a requirement. Compliance of course provides cover against legal exposure. We owe it to our clients to deliver performance, and we should not be delivering rule compliance solely for our own reduced-exposure purposes. Legacy practices become more questionable over time, as materials and processes change. If there is any ethical obligation in roof consulting, it is to assign greater importance to delivering performance to the client than complying blindly with legacy practices and values.

Weatherization and energy-retrofit contracting is becoming very skilled at adding tightness to the ceiling. The industry has the tools at hand to do zone pressure testing as part of blower door tests. These two skills by themselves—air tightening and diagnostics—should provide excellent overall performance of residential attics in existing buildings.

William B. Rose



William B. Rose is senior research architect at the Prairie Research Institute, part of the University of Illinois at Urbana-Champaign. His research is in building performance, particularly the heat and moisture performance of building envelopes. For 12 years he was the handbook chair for the *ASHRAE Handbook* chapters on building envelopes. In 2005, he authored *Water in Buildings*, published by Wiley & Sons. His current research is with the U.S. Department of Housing and Urban Development, to determine concentrations of common air compounds in homes that are weatherized and mechanically ventilated. Mr. Rose was recently named an ASHRAE Fellow.

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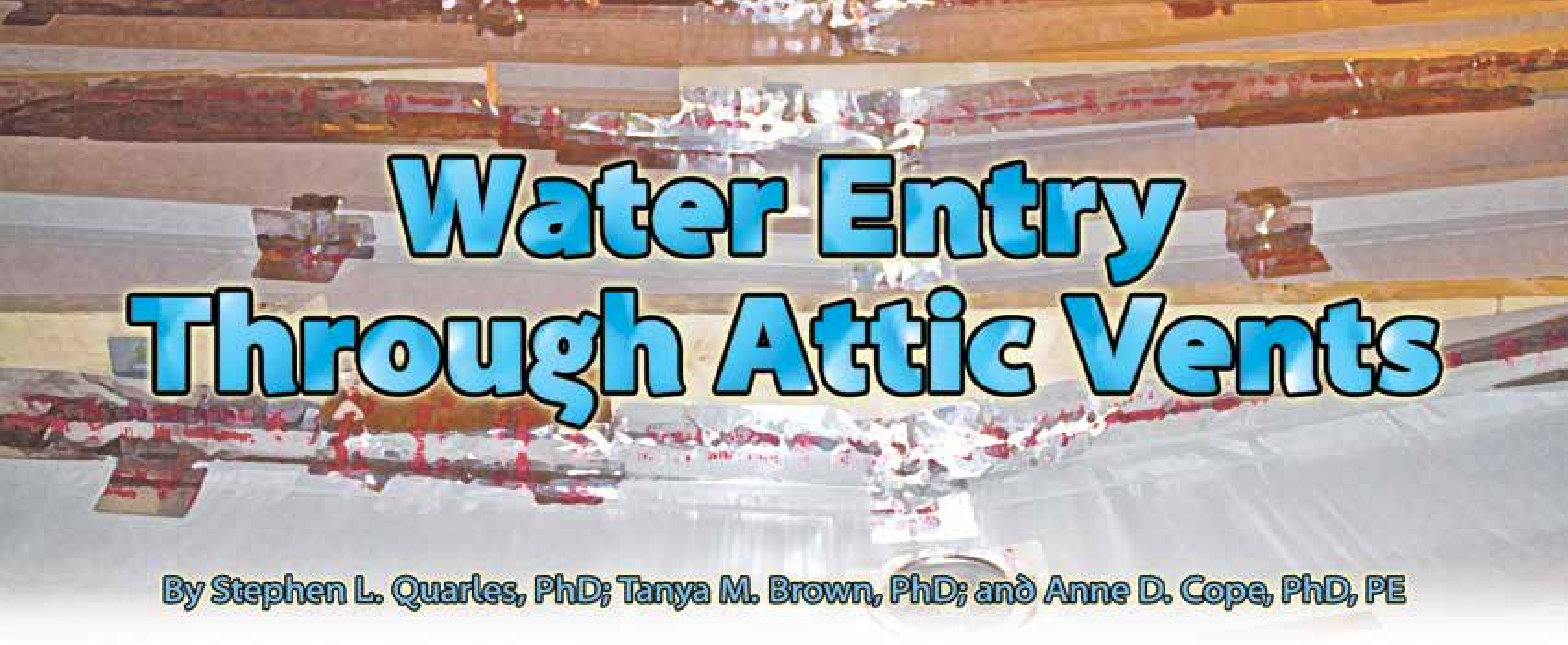

Water Entry Through Attic Vents

By Stephen L. Quarles, PhD; Tanya M. Brown, PhD; and Anne D. Cope, PhD, PE

INTRODUCTION

Recent testing at the Insurance Institute for Business and Home Safety (IBHS) Research Center provided an opportunity to quantify the amount of water entry that occurred through selected attic vents commonly used in residential construction during simulated wind-driven rain exposures.

Water penetration can cause extensive damage to interior finishes and can lead to ceiling collapse when attic insulation is saturated. When power is lost and/or a house cannot otherwise be dried out within 24 to 48 hours, additional moisture-related difficulties are common, extending the time during which the property may not be available for use. IBHS researchers investigated whether adopting installation methods for soffit covers that reduced the chance of detachment during high-wind events could reduce human inconvenience and financial costs associated with water entry during hurricanes. Additionally, IBHS testing investigated water entry through gable end vents. The Research Center testing was an extension of work done following an IBHS post-disaster field investigation into damage caused by Hurricane Charley in 2004, after which IBHS developed recommendations and procedures for installing soffit material.[1]

EXPERIMENT

A full-scale duplex building was designed and constructed for this study. The building included gable ends fitted with nominal 1.5- x 2-ft. (0.46- x 0.6-m) gable end vents and nominal 1-ft. (0.3-m)-wide soffits at the eaves. In this series of tests, water entry through the soffit material (both installed and not installed) and through gable end vents was evaluated (*Figure 1*). A wind-driven rain deposition rate of 8 in./hour (203 mm/hour) was used. This rate was based on the value specified for wind-driven rain

Figure 1 – End view of the building, showing location of gable end vent (open) and soffited eave. Note: Some of the panels have detached as a result of exposure to the elevated wind speeds.

Figure 2 – Water collection channels between ceiling trusses in the attic of the test building.

Figure 3 – Water collection system inside the test building.

in ASTM E331-00. Wind speeds of 30, 50, and 70 mph (13.4, 22.4, and 31.3 m/s) were used.

In the first three tests (*Table 1*, Tests 1-3), water entry through the eaves was evaluated with no soffit material installed, to simulate a case where the soffit covering (see *Figure 1*) detached during a high-wind event. Subsequent testing was conducted after the perforated vinyl soffit covering was installed (*Table 1*, Tests 4-8). Water entry through the gable end vent was also evaluated with (*Table 1*, Tests 3-4) and without (*Table 1*, Tests 1-2 and 5-8) a plywood covering attached to the outside of the gable end vent. Additional testing details are provided in the Testing Program section of this article.

Establishing Wind-Driven Rain Capabilities

IBHS provided financial support to the University of Florida (UF) to assist with deployment of a research disdrometer during Hurricane Ike in 2008 to measure and record the size distribution of raindrops. UF developed a novel instrumentation platform that continuously aligned the disdrometer with the mean rain direction to take measurements of rain droplets in extreme winds. Additional financial support was provided by IBHS for a graduate student to analyze the rain droplet size distributions from the data and to use the UF wind simulator to select a commercially available spray nozzle that would produce a similar distribution of rain droplet sizes. Matching droplet size is critical because the momentum of large drops will cause them to ignore the effects of wind flow around the building, while tiny drops will simply follow the flow and not wet the surface of the building. Prior to conducting the water entry measurement testing, validation tests were run in the large test chamber at the IBHS Research Center using the same research disdrometer.

Measuring Water Entry Rates

Drainage panels and tracks (DrySpace™)

were installed in the attic of the test building to create water collection channels between the ceiling trusses, as shown in *Figure 2*. These channels were outfitted with drains and pipes that allowed water to be collected in plastic containers arranged throughout the interior (nonattic) space in the two halves of the building. The drainage system was installed so that the collected water could be segregated by zones. These zones were roughly 10 ft. (3 m) long by 2 ft. (0.6 m) wide. The trusses extended from the front to the back of the test building. The between-truss spacing was divided into three sections, each about 10 ft. (3 m) long. Typical drain and collection locations are shown in *Figure 3*. Each test was conducted for a 20-minute period, during which a constant wind speed was maintained. At the completion of each test, water in the buckets was measured and recorded.

Test No.	Test Duration, s	Wind Speed, m/s	Perforated Vinyl Soffit Condition	Gable End Vent Condition	Building Orientation	Dominant Water Entry Options
1	1,200	22.4	Removed (Open)	Uncovered	Normal to back of building	Open soffit
2	1,020[1]	31.3	Removed (Open)	Uncovered	Normal to back of building	Open soffit
3	1,200	22.4	Removed (Open)	Covered	Quartering wind	Open soffit
4	1,200	22.4	Installed	Covered	Quartering wind	Soffited eave
5	1,200	22.4	Installed	Uncovered	Normal to back of building	Soffited eave
6	1,200	31.3	Installed	Uncovered	Normal to back of building	Soffited eave
7	1,200	22.4	Installed	Uncovered	Normal to end of building	Gable end vent and soffited eave
8	1,200	13.4	Installed	Uncovered	Normal to end of building	Gable end vent and soffited eave

[1]The duration of Test No. 2 was 180 seconds shorter than the other tests because the water collection system had reached its capacity.

Table 1 – Summary of under-eave and vented opening water entry tests.

Testing Program

Summaries of the testing program are provided in *Tables 1* and *2*. The first sequence of tests, designated as the removed/open soffit tests, involved measuring water entry when the soffit cover was missing along the entire length of the back eave of the building (*Table 1*, Tests 1 - 3). The gable end vent was uncovered during Tests 1 and 2 to promote airflow in the attic and was covered with plywood during Test 3 (the quartering wind test) to limit water entry to the open soffit. The open under-eave area along the wind-driven, rain-exposed face of the test building was approximately 37.5 sq. ft. (3.5 m^2). The second series of tests, designated as the installed soffit tests, involved measuring water entry with a perforated vinyl soffit material installed (*Table 1*, Tests 4 - 6). The perforated vinyl soffit material consisted of uniformly spaced holes, each 0.125 in.

Building Orientation (relative to wind direction)	Gable End		Soffit	
	Vent Covered	Vent Uncovered	Vented Soffit Material Installed	Vented Soffit Material Not Installed
Normal to Back of Building		X	X	X
Quartering Wind	X		X	X
Normal to End of Building		X	X	

Table 2 – A summary of gable-end and soffited-eave condition during the water entry tests.

Wind Speed, m/s	Opening Condition and Building Orientation				
	Open Soffit		Perforated Vinyl Soffit		Gable End
	Head On (0°)	Cornering (45°)	Head On (0°)	Cornering (45°)	Head On (90°)
	Accumulation, mm/hr (%)[1]		Accumulation, mm/hr (%)[1]		Accumulation, mm/hr (%)[1]
22.4	33.0 (16)	40.6 (20)	1.9 (1)	1 (0.5)	~200 (100)
31.3	73.7 (36)	-----	17.3 (8)	-----	-----

[1]Percent entry relative to the target wind-driven rain deposition rate of 203 mm/hr (8 in./hr).

Table 3 – Water entry measurements for the eave and gable end conditions.

(3 mm) in diameter. Testing with the covered soffit was conducted when the building was perpendicular to the wind direction and also at 45° off perpendicular to the wind direction (a quartering wind). The third test sequence evaluated water entry through the open gable end vent when the gable end of the building was perpendicular to the wind direction (*Table 1*, Tests 7 and 8). In each of these tests, the perforated soffit was installed. These tests were conducted with 30- and 50-mph (13.4- and 22.4-m/s) wind speeds.

RESULTS AND DISCUSSION

The amount of water that entered into the attic space, as a function of the area of the opening, is shown in *Table 3*. A wind speed of 50 mph (22.4 m/s) produced an overall water entry rate into the attic of about 33 mm/hr based on the area of the soffit. This was about 15% of the total rainfall of 8 in./hr. (203 mm/hr) deposited on the adjacent vertical wall surface. Most water was deposited within the first 10 ft. (~3 m) of the attic space immediately adjacent to the open soffit. A wind speed of 70 mph (31.3 m/s) produced an overall water entry rate into the attic of about 2.9 in./hr (74 mm/hr) based on the open area of the soffit. This was a little more than 33%

of the deposition rate on the vertical wall surface. A quartering wind of 50 mph (22.4 m/s) produced an uneven distribution of water in the attic, but still resulted in about 1.6 in./hr (40 mm/hr) based on the open area of the soffit. This was about 20% of the deposition rate on a wall surface facing the wind flow.

During the test with the perforated soffit cover installed, a wind speed of 50 mph (22.4 m/s) resulted in water accumulation in the attic space of approximately 6% of the amount of water that entered during the same test for the open-soffit case. A wind speed of 70 mph (31.3 m/s) produced about nine times more water accumulation in the attic than the lower 50 mph (22.4 m/s) wind speed test. This was about 25% of the amount of water that entered the attic for the open-soffit case at the wind speed of 70 mph (31.3 m/s). A quartering wind of 50 mph (22.4 m/s) produced very little accumulation of water in the attic. The amount was about 2.5% of the water entering during the same test for the open-soffit case.

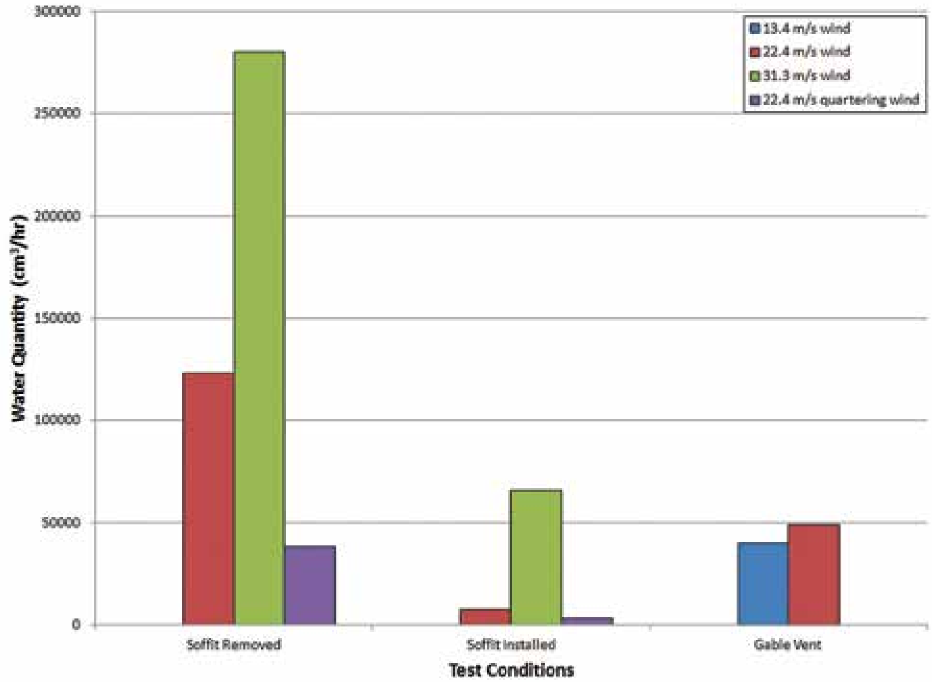

Figure 4 – Total amount of water entry into the attic per hour for under-eave and gable end conditions.

Regardless of wind speed, water entry through the gable end vent was nearly equal to the wind-driven water deposition rate based on the area of the vent. There was a slight indication of less water entry for higher wind speeds, but this difference could have resulted from water that was blown further into the attic in an area around the attic access stairs where collection pans were not in place.

A graph comparing the volume of water collected through the gable and soffited eave openings is shown in *Figure 4*. Note the difference between water entry through the soffit when installed versus removed. Water entry through the open soffit was several times higher than that with the soffit cover installed, demonstrating the importance of keeping the soffit material intact during high-wind events. Water entry through the eave (soffit material installed or removed) more than doubled when the wind speed was increased from 50 to 70 mph (22.4 to 31.3 m/s). Water entry through the gable end vent was not as affected by wind speed. Although the 70-mph (31.3-m/s) condition was not tested for gable end vents, the amount of water entry measured at the 30- and 50-mph (13.4- and 22.4-m/s) wind speeds was similar; and in each case, most of the water impacting the vent entered the attic.

SUMMARY AND CONCLUSIONS

These initial tests demonstrated that wind-driven rain will enter through open soffits and gable end vents. Installation of soffit materials using appropriate techniques, which reduce the chance of detachment during high-wind events, will therefore reduce the amount of water that enters attic spaces. Almost all wind-driven rain that impacts the gable end vent will enter the attic. In this case, the total amount of water that enters the attic will be a function of the size of the vent. Covering the vent prior to hurricanes and other high-wind events where rain is likely will reduce water entry into the attic. Using alternate venting systems that don't utilize gable end vents is also an option during new construction or reroofing. As a preliminary study, this work suggests more investigation is needed to quantify the amount of water entry that can be expected for normal construction and how much water entry is likely to be reduced with various water-entry prevention measures.

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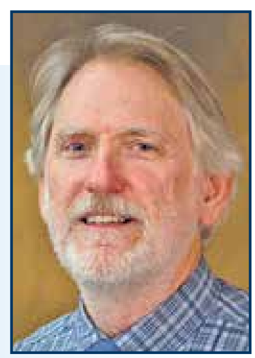
Ann Cope, PE, PhD

Dr. Anne Cope, PE, joined IBHS in 2009, having previously worked at Reynolds, Smith & Hills, Inc., where she served as a project manager and structural engineer in support of NASA, the Department of Defense, and commercial launch operations. As vice president of research at IBHS's new multiperil research facility in Richburg, SC, she is responsible for developing and guiding the research program. Her previous research has encompassed topics ranging from the simulation of full-scale wind effects on buildings to detailed studies of the vulnerabilities of buildings to natural hazards and the development of damage-prediction models. Cope's experience also includes time served as an officer in the U.S. Army. She earned her BS and MA in civil engineering from Clemson University and her PhD from the University of Florida. She is a registered professional engineer in the state of Florida.

Tanya M. Brown, PhD

Dr. Tanya Brown joined IBHS in August 2010 as a research engineer. Her research focus is on hailstone formation, hail impact testing, wind-flow characterization and testing, instrumentation, and field and damage assessment studies. Brown previously served as an engineering consultant for IBHS when she conducted research on the Witch Creek wildfire and development of the hail research agenda for the Research Center. She has also worked as an engineering consultant for LNSS & Associates. She was a National Science Foundation – Integrative Graduate Education Training Fellow while completing her PhD in wind science and engineering at Texas Tech University. Brown also holds an MS in water resources science and a BS in atmospheric science from the University of Kansas. She is currently a faculty associate at Texas Tech and continues serving with the Texas Tech University Hurricane Research Team.

Stephen Quarles, PhD



Dr. Stephen Quarles joined the IBHS Research Center team in 2011 as the senior scientist for hurricane and high-wind building durability and fire protection. He is the S.C. High Wind and Hail Underwriting Association chair at the lab. Prior to joining IBHS, he retired from the University of California as a cooperative extension advisor in addressing the durability and in-service performance issues of wood-frame buildings, particularly those subjected to wildfires. He originally joined the university in 1985 and was made cooperative extension advisor in 2000. During 2007 and 2008, Steve also worked part-time with the California office of the state fire marshal, during which he developed, coordinated, and served as an instructor for the educational program related to the Wildland-Urban Interface (wildfire) Building Code and Standards. Quarles is a member of the Society of Wood Science and Technology board of directors, the American Society of Testing and Materials, the American Wood Protection Association, the National Fire Protection Association, and the Association of Natural Resource Extension Professionals. He earned a BS in forestry from Virginia Tech and MS and PhD degrees in forest products from the University of Minnesota.

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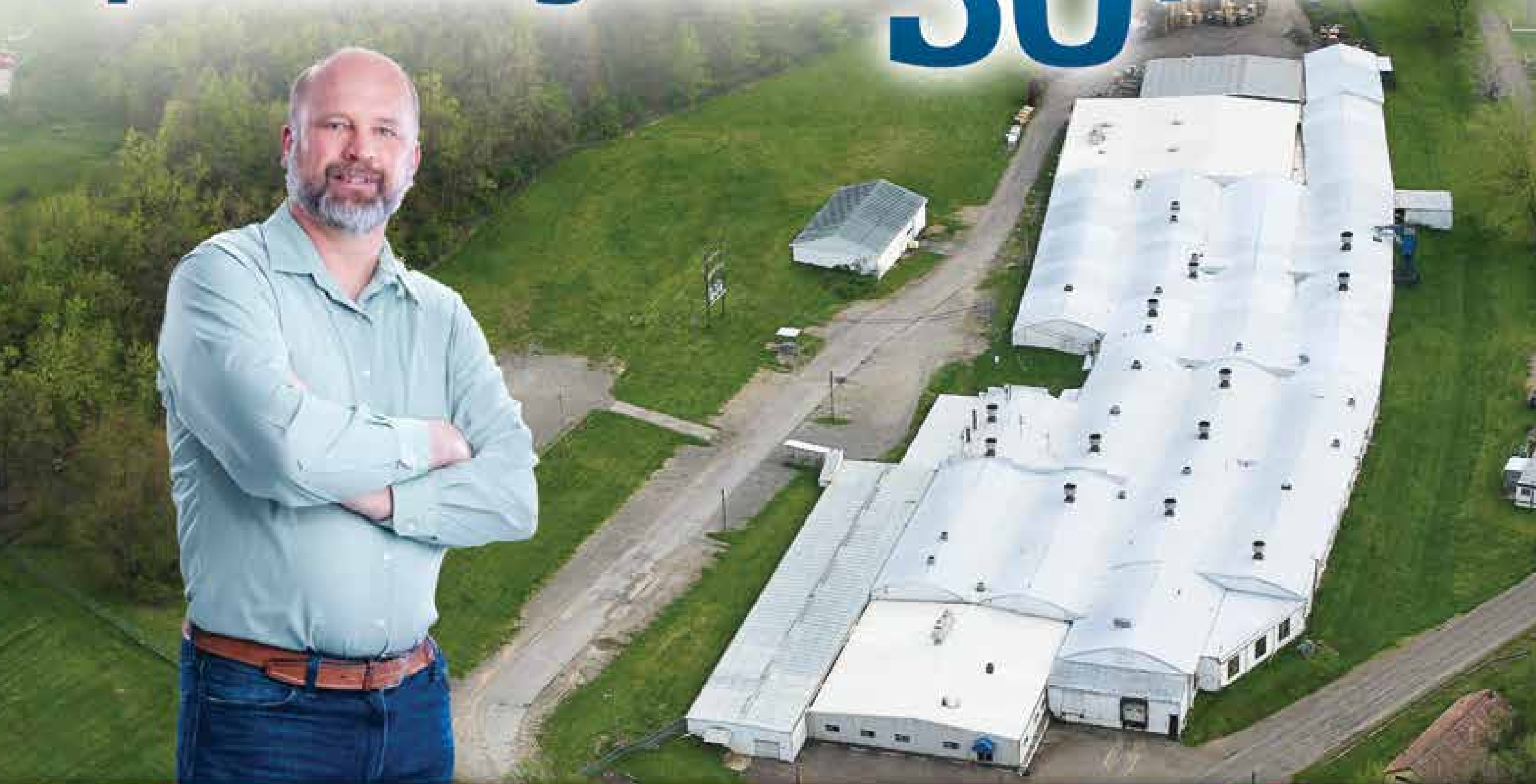

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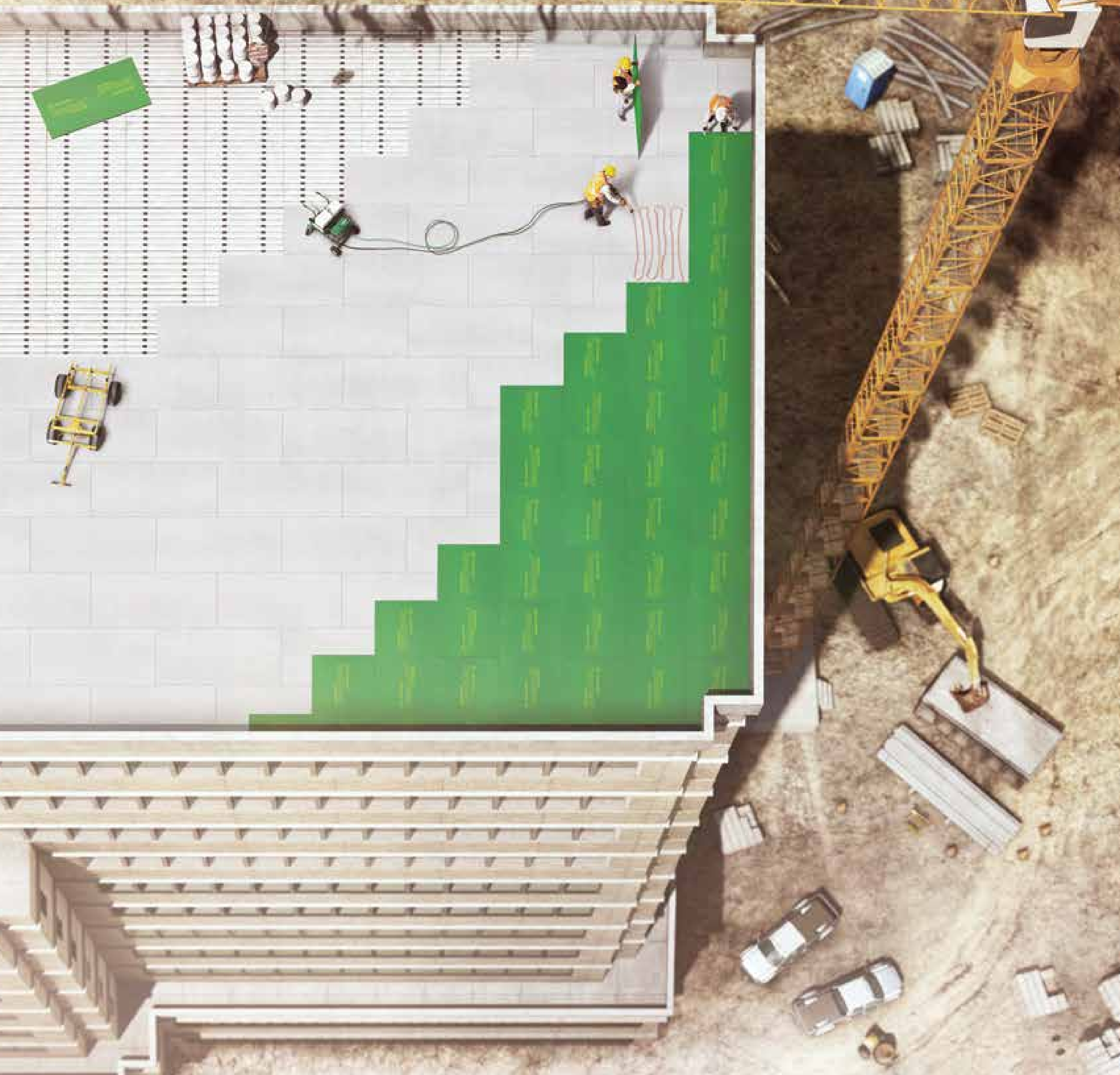

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"COOL" ROOFS CAUSE CONDENSATION — Fact or Fiction? —

By Phil Dregger, RRC, FRCI, PE

This article is reprinted, with permission, from the January/February 2012 issue of **Western Roofing.**

It's not so unusual. Right after the first couple of sunny spring days, you get a call. The owner complains his roof is leaking, but it hasn't rained for a week. You investigate. It is not a roof leak, it is condensation, and "dripping" is just part of the problem. You find a wet roof deck with something that looks a lot like mold growing on it.

Sometimes this scenario plays out shortly after a conventional built-up roof was replaced with a "cool" roof. And when that happens, the question often is if the cool roof caused the problem. "After all," the owner says, "condensation was never a problem before."

Back to the question raised by the title of this article. Do cool roofs cause condensation? The answer is (drum roll, please): It depends. For many if not most reroofs, installation of a cool roof brings the benefit of reduced summer cooling costs and few drawbacks. For other reroofs, installation of a cool roof can cause condensation problems. In most cases, however, the cool roof is more like the "straw that breaks the camel's back"—it inadvertently disrupts a delicate balance.

Usually it turns out the old, noncool roof had been accumulating large amounts of moisture in the wood deck during the winter months for years with no apparent problem. The old roof—usually a cap-sheet surfaced built-up membrane—had helped keep moisture in check by getting fairly hot and facilitating downward drying every time the sun came out—winter or summer. Then, after installation of the cool roof, the roof no longer got very hot, and this changed the balance between wetting and drying. The wood deck was still accumulating moisture like it did before, but now it was not drying nearly as rapidly or as completely as before. This can cause occasional early spring dripping or worse. It sometimes causes wood decay and fungal growth where they did not occur previously, at least not to a noticeable extent.

Figure 1 shows severely deteriorated plywood discovered a few years after replacing an old cap-sheet built-up roof (BUR) with a white single-ply roof in the San Francisco Bay Area. Workers sent to investigate reports of the roof dripping found no obvious openings for roof leaks but found many so-called "soft spots." Before the white single-ply roof was installed, the old BUR had been in place for many years without similar reports of dripping or soft spots. Changing from a noncool roof to a highly reflective cool roof is believed to have at least contributed to these problems.

It is important to mention that the causes of condensation in roof systems are many and varied. Buildings with conventional non-cool roofs can develop condensation problems, and changes other than

Figure 1 – Severely deteriorated plywood a few years after replacing an old cap-sheet BUR with a white single-ply roof.

Figure 2 – Severe deterioration caused by water vapor migrating up through the ceiling of a laundry room.

those to roof reflectance (e.g., building use, HVAC operation) can negatively tip previously maintained balances between the wetting and drying of roof systems. This article focuses on the potential impact of increasing the reflectance of low-sloped roof systems installed on commercial buildings directly over wood deck with fiberglass insulation below—a common West Coast construction practice.

WEST COAST CONSTRUCTION

It is quite common in the western states to construct commercial buildings with wood decks and to install thermal insulation—usually fiberglass batts with facers—below the deck. For the rest of the country, it is more common to install some sort of rigid board insulation above a steel or concrete roof deck.

Wood roof decks with glass fiber batts installed below tend to accumulate more moisture, in general, than wood decks with rigid board insulation installed above. This is true for a couple of reasons:

- The temperature of the wood deck tends to track that of the roof membrane (and outside air) rather than that of the air inside the building. This means that in cold weather, the temperature of wood decks regularly drops below the dew point of the interior air.
- Wood sheathing decks, by their very nature, can serve as reasonable air retarders; while glass fiber batts, even with vapor retarder facers, do not. Openings and air spaces associated with glass fiber batts installed below roof decks allow relatively large amounts of interior air to intrude up into the thermal insulation. The exception, of course, would be a below-deck insulation system that has been carefully sealed against air intrusion.

To understand why these considerations make a moisture accumulation difference, we need to talk a little about condensation and the profound impact of air intrusion.

CONDENSATION BASICS

During the winter, the air inside a heated and occupied building typically contains more water vapor than the air outside. The higher water vapor level inside works to equalize itself with the lower level outside by migrating or diffusing out through the walls and ceilings. It's kind of like air slowly escaping a balloon. As the water vapor migrates, it also cools. And, if it cools below its dew point, it will condense on one of the components within the roof or wall assembly. This is true of all roof and wall systems.

Figure 2 shows severe deterioration caused by water vapor migrating up through the ceiling of a laundry room (with insulated rafter spaces) and condensing on the cold underside of the roof membrane and plywood roof deck. Eventually, the plywood got wet enough, warm enough, and for long enough to support the growth of wood decay fungi.

MILD CLIMATE EXAMPLE

Severe conditions can develop—even in mild climates. *Figure 3* shows stains on the sides of beams in an office/warehouse building in California. The owner reported that the BUR was quite old, but it had been

Figure 3 – Stains on the sides of beams in an office/warehouse building in California.

recently overlaid with a highly reflective, reinforced elastomeric coating system. And although he remembers previously getting occasional reports of drips in the spring, the owner was sure he never got the kinds of reports he was getting now of widespread water dripping and even of water-soaked insulation falling to the floor (*Figure 4*). He mentioned, however, he still was not getting any reports of leaks during rains.

Although apparently not the case in this example, rainwater leaks from openings in roof covering systems (usually at flashings) remain the most common causes of roof moisture problems. Roofs over wood decks with insulation below are no exception.

Nevertheless, this project is believed to be an example in which installation of a cool roof inadvertently caused problems by changing the balance between wetting and drying, and the physics agrees.

Figure 4 – Water-soaked insulation.

WUFI PRO 5.1

Results of simulations run over a three-year period using WUFI Pro 5.1, a sophisticated hygrothermal computer modeling program, indicated that the wood deck below the BUR after installation of the reflective overlay accumulated more water and held it longer than it did before.

Figure 5 indicates WUFI-predicted fluctuations in temperature and relative humidity (a measure of the water present) near the bottom surface of the plywood roof deck with the original built-up roof. *Figure 6* indicates WUFI-predicted fluctuations in temperature and relative humidity (RH) after installation of the highly reflective overlay. Superimposed on both figures are yellow lines representing 80% relative RH and 41°F.

The WUFI graphs indicate that, after installation of the reflective overlay, the plywood did not get as hot (e.g., maximums near 115°F rather than 155°F), accumulated more water (higher RH), and held it longer than it had previously.

Is this predicted difference important? According to a new ANSI/ASHRAE standard, yes, it could make a significant difference.

ANSI/ASHRAE Standard 160-2009, *Criteria for Moisture-Control Design Analysis in Buildings*, recommends specific performance criteria to "minimize the undesirable effects of moisture in a building or building envelope." Among other things, the standard recommends roof and wall systems be designed to limit how high the RH of materials like wood gets and for how long. One criterion is that the "30-day running average surface RH <80% when the 30-day running average surface temperature is between 41°F and 104°F." Again, the yellow lines in *Figures 5* and *6* represent 80% RH and 41°F temperature.

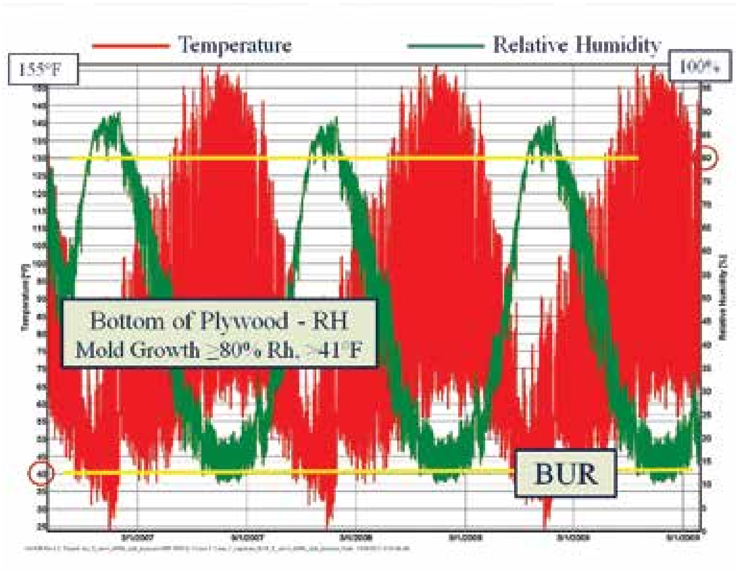


Figure 5 – WUFI-predicted fluctuations in temperature and RH near the bottom surface of the plywood roof deck with the original BUR. The yellow lines represent 80% RH and 41°F temperature.

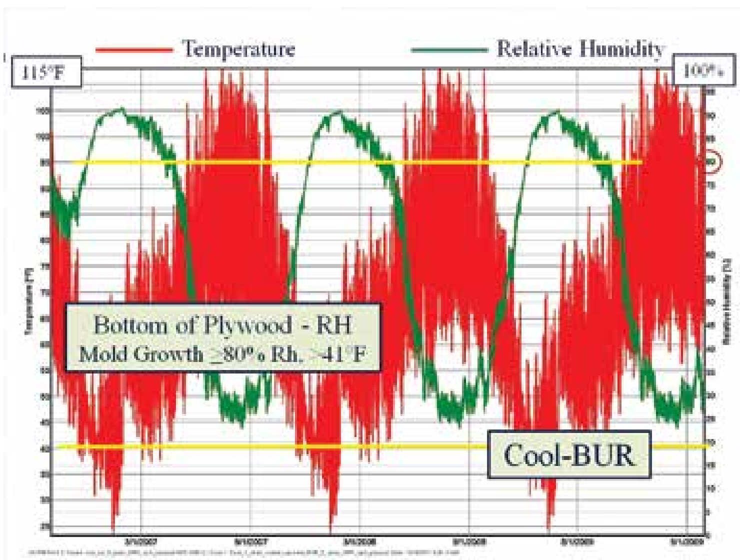


Figure 6 – WUFI-predicted fluctuations in temperature and RH after installation of a highly reflective overlay. The yellow lines represent 80% RH and 41°F temperature.

Even without considering the effects of air intrusion, the impact of changing from a relatively nonreflective roof to a highly reflective roof can make a significant difference.

THE PROBLEM OF AIR INTRUSION

If there is enough humidity inside and it's cold enough outside, condensation can be a problem regardless of roof construction or air intrusion. However, with air intrusion, buildings with relatively modest amounts of humidity inside and located in relatively mild climates can accumulate large amounts of water and suffer from wood rot and mold growth in localized areas.

The issue is how much water vapor actually finds its way to where the below-dew-point temperatures are. If the water vapor has to diffuse through several layers of materials before it starts condensing, the volume of water that ends up condensing or being absorbed is rather modest—low enough that wood doesn't rot, mold doesn't grow, and water doesn't drip in the early spring.

If, instead of diffusing, water vapor is carried along on a current of air through modest openings in the ceiling construction, very large volumes of water can end up accumulating and fueling wood rot, mold growth, and spring dripping. Air-intrusion-related condensation is usually localized and exhibits some pattern consistent with the openings that allowed it to occur.

Figures 7 and *8* show roof construction along truss purlins where modest gaps in the foil-faced batt insulation allowed interior air to enter, condense, and accumulate on the wood deck during cold weather. In the spring, with higher temperatures and plenty of water to work with, very high vapor pressures were created at wood deck level, forcing water vapor downward where it condensed on nearby metal surfaces and dripped out.

Cautions about air intrusion are not new. The 1985 version of ASTM C755 states, "The quantity of water vapor that can be transported by air [intrusion]… can easily be several times greater than that which occurs by vapor diffusion alone." The *ASHRAE Fundamentals* book, published in 1989, states, "The relative amounts of water deposited in a wall or roof… as a result of air leakage as by vapor diffusion… [can] be 100:1 or higher."

VENTILATION

Would venting of the space between the wood roof deck and the insulation have helped? Yes, it probably would have.

First, let's be clear. The space between the wood roof deck and the below-deck insulation is not vented on the vast majority of commercial buildings with low-sloped roofs in the western states. And it can be argued that providing such venting is not something practically done as part of a reroof project. However, when condensation problems develop as part of a reroof project, the question of whether or not venting of this space was—strictly speaking—required to comply with the current building code is

Figure 7 – Roof construction along truss purlins.

something that often ends up being asked.

BUILDING CODES

All roof systems—including reroof systems—need to designed, installed, and maintained in accordance with local codes. This includes provisions for attic ventilation. This article will reference provisions in the 2009 International Code Council family of codes, since they serve as the model code for the codes adopted by most states and municipalities.

The 2009 International Building Code, Chapter 12, Interior Environment, 1203.2 Attic Spaces, states, "Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof framing members shall have cross ventilation for each separate space." Unfortunately, what exactly qualifies as "an enclosed rafter space" is not defined. Do the rafters have to be sloped? Securing gypsum boards to the bottom of the rafters probably qualifies as enclosing the spaces, but what about sheets of vinyl or foil or kraft paper? And, if the project already has unvented yet enclosed rafter spaces, is the contractor installing a new roof responsible for making it code-compliant?

The phrasing of this familiar "attics and enclosed rafter spaces" venting provision has changed over the years. Older codes (e.g., the 1997 Uniform Building Code) prefaced it with the caveat, "Where determined necessary by the building official due to atmospheric or climatic conditions." The current wording seems to imply that the basic applicability of this provision is no longer subject to local weather or climate.

Living in the litigious society we do, the suggestion of this author is, "When in doubt, obtain an interpretation from the authority having jurisdiction (AHJ)—usually the local building official. Afterwards, pro-

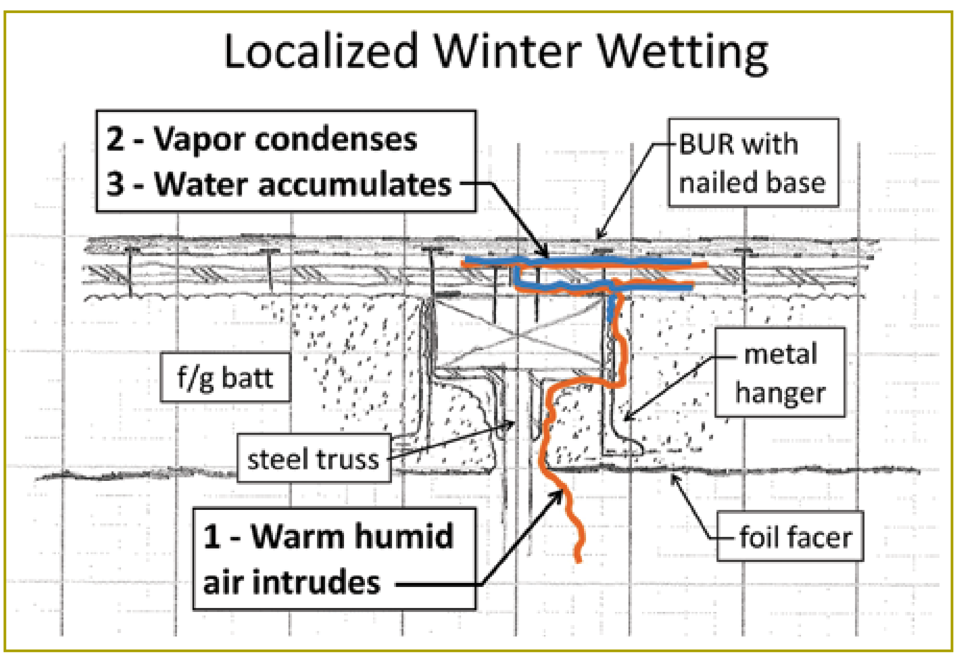


Figure 8 – Localized winter wetting.

vide a courtesy e-mail back to the building official thanking him/her for the information; and, by the way, keep the e-mail in your files.

There are other building and energy code provisions that, when complied with, serve to limit the amount of water vapor that enters and accumulates in a roof system (e.g., installation of vapor retarders; sealing of "openings, joints, and penetrations" in the exterior building envelope; ventilation of interior spaces), but discussion of these is beyond the scope of this article.

COMBATTING COOL ROOF EFFECTS

When the combination of a cool roof and air intrusion results in condensation problems, there are several different ways to help remedy the situation. Examples, which can be used alone or in combination, follow:

- Add insulation above the roof deck.
- Reduce RH inside.
- Install a vapor-permeable air retarder system below the insulation.
- Provide cross ventilation for each separate enclosed space (typically not practical).

In the opinion of the author, the most effective of these procedures is to insulate above the roof deck.

As long as the common roof industry guidelines suggest that condensation (due to water vapor diffusion alone) should not be a problem, adding insulation above the deck should do the trick. The key here is to warm the surfaces most likely to be exposed to the intruding air. Adding insulation above the roof deck does just that. It warms the roof deck to temperatures closer to that of the interior spaces than that of the exterior environment. Thereafter, even if large amounts of moisture-laden air come in contact with the wood deck, it does not condense because the wood is at or above the dew point of the air.

How much insulation needs to be added and whether or not the below-deck insulation needs to be removed are important questions but must be evaluated on a project-to-project basis. The good news is that for most projects, a relatively modest amount of R-value on top can make a big difference below.

A TWO-EDGED SWORD

Installing vapor retarders can be a very effective way to limit the amount of water vapor that enters a roof system and thereby control condensation. They can also have a downside: They can trap moisture. This is not necessarily intuitive. One could ask, "Don't vapor retarders 'keep out' as much as they 'trap?'" Yes, but only if the vapor retarder is also effective at preventing air intrusion, which is not easily accomplished on glass-fiber batt insulation systems installed below decks with pipes and ducts in the way.

If modest openings in a vapor retarder inadvertently allow air to move in volume up into a roof system, the presence of a vapor retarder can have a net negative impact on water accumulation, at least in localized areas. This is because the forces working to drive moist interior air up into roofs in the winter are routinely greater than the forces working to drive it back down again. Without going into detail, the following are some reasons why more water vapor is driven up into roofs in the winter than down.

- Warm air rises.
- Humid air rises. While this is not intuitive, it's true.
- Still air tends to move toward moving air. During winds, the air above the roof is at a lower pressure than the air inside. Differences in air pressure, like differences in vapor pressure, try to equalize, working to move interior air up into the roof system.

In the experience of this author, installing a vapor retarder below existing below-deck insulation systems often has less than desirable results. On the other hand, installing a vapor-permeable air-retarder-type system is almost never a bad idea. Keep in mind that not just any material is suitable. Materials exposed to occupied spaces need to stay below certain maximum levels of flame spread and smoke development.

SUGGESTIONS

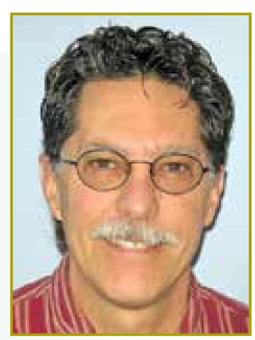
When roof professionals are asked to design and/or install a cool roof on an existing wood deck with insulation below the deck, this author recommends the following:

- Ask about reports of spring roof leaks and/or recent energy-efficiency projects that may have inadvertently increased interior RH.
- Check for enclosed unvented rafter spaces and for signs of past below-deck moisture accumulation (e.g., stains running down beams at purlin hangers).
- Comply with codes, including local amendments, and recognized roof design aids. Seek interpretations, if needed, from the local building official.
- Recommend adding insulation above the roof deck as part of the reroof, even when not required by the energy code (e.g., roof overlays).
- Advise the owner or the owner's design professional of potential changes in moisture accumulation and drying associated with installation of cool roofs.

ACKNOWLEDGMENT AND FURTHER READING

The author wishes to thank Wayne Tobiasson for useful comments and suggestions during preparation of this article. For additional information, readers are directed to the following links for other articles by this author on the topic of condensation in roofs: http://www.trsroof.com/Pubs/Dregger/2006-12-dregger.pdf and http://www.trsroof.com/Pubs/Dregger/2002-06-dregger.pdf.

Phil Dregger, RRC, FRCI, PE



Phil Dregger is a professional engineer, registered roof consultant, and fellow of RCI, Inc. He has investigated problems and provided expert testimony on virtually all roof and waterproofing systems, including below grade. He has special expertise in roof wind damage, collapse due to inadequate roof drainage, and analysis of roof/wall condensation problems. Dregger has authored many articles on roof technology, including his 2009 paper, "Rooftop Photovoltaics – How to Save Money on Energy and Avoid Spending It All on Roof Repairs." Phil can be reached at 925-356-7770.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THE CALLBACK

BY MARLEA R. KNOX, CDT

THE CALLBACK

With hundreds of thousands of roofing contractors across the country, it is doubtful that there is a single contractor out there who has never been "called back" to a project. The callback may have been to thank the contractor, to get closeout documents, or even to discuss a future project; however, some of those callbacks started with something along the lines of a customer, building owner, facility manager, architect, consultant, or general contractor complaining about the roof leaking.

Imagine, though, that you are a roofing contractor who has just received a call that the roof your people put on a school a few months ago is now leaking. The call is a huge blow to the ego and a potential financial liability. The very thought that someone could even consider questioning your work when you have been in business successfully for decades is unthinkable.

After the initial shock has set in, you determine to personally inspect the situation yourself to work toward restoring the good reputation of your company. A meeting is set up at the project location with the architect, consultant, and facility manager to review the situation. To prepare for the meeting, you dig out the project file and review all the information to ensure everything was done as specified.

THE PROJECT

The project was a large middle school in the northern Midwest that was reroofed that summer. The school had been due for a new roof, and the architect and consultant on the project designed it with a vented nailbase system. They specified a 1-in. air space and a single layer of 2½-in. insulation. Neither you nor any of your crews had worked with a vented nailbase system in the past, but you did some research on the installation process and bid the project. Your company was awarded the work.

The timeline on this project was critical. You couldn't start until after school was out for the year, and everything needed to be done before school resumed in the fall. You had guys there from sunup to sundown, six days a week, to ensure everything was done in time for school to resume on schedule.

The school had a four-on-twelve sloped roof and was being reroofed with dark asphalt shingles. The company's primary business is sloped roofs with asphalt shingles. You have a couple of crews and do over a dozen of them each year. This project was a perfect fit for the company.

THE MEETING

Despite how upset you were when you received the initial call, you decided to listen to their concerns and accusations before jumping to any conclusions or denying the claim.

Figure 1 – Vented nailbase with sheathing cut out.

ICE DAMMING

From the moment you pulled up to the school, you could tell that there were major ice dam issues. That was bad enough, but there were even ice dams on the canopy of the playground entry to the school, where hundreds of children enter and exit each day. In addition, the large ice dams were filling up the gutters, and their weight was destroying them. There were actually areas where the gutters were starting to come off, as they could not hold the weight of the ice. It was no wonder that the facility manager was upset, but this was not a leaky roof.

If there is insufficient airflow, it can cause ice damming. The 1998 Cold Regions Research Engineering Laboratory (CRREL) studies by Wayne Tobiasson concluded just that: A combination of roof ventilation and insulation is the most reliable approach to eliminate problematic ice dam formation. Because of this study and many other contributing factors, the International Building Code (IBC) guidelines require a minimum of 1 inch of air space with no interference in the air movement by blocking or bridging. (Section 1203 of the IBC, "Ventilation," can be referenced for the full guidelines on roof ventilation.) This results in a minimum of 12 sq. in. of net free area per linear foot. One-inch premanufactured vented nailbase systems do not provide 12 sq. in. of net free area per linear foot when the spacers are taken into account. On average, a 1-in. air space in a vented nailbase system provides only 9 sq. in. of net free area per linear foot. A 1½-in. air space can be used in most cases to meet the code requirement; however, this is not appropriate for all building designs.

Figure 2 – Vented nailbase with a single layer of insulation.

CONDENSATION

After seeing the major ice dam issues, the facility manager proceeded to lead you, the architect, and the consultant inside the school, where the problems continued. As you walked into the playground entrance, the facility manager asked that you turn around. Before he could explain, you saw large dark brown stains running down the walls in the corner. Following the stains up, you saw large spots on the ceiling—water stains from the huge ice dams forming on the outside. These you could understand, given the amount of moisture in the area. What you did not expect, however, was staining from what appeared to be moisture in various other places throughout the school, including some classrooms, storage closets, bathrooms, and the kitchen.

Structures located near water or in humid regions are more susceptible to condensation damage because the air there has a higher relative humidity. This school is close to Lake Erie; however, that would not contribute to this much condensation.

This would take some investigation—removal of small patches of the ceiling and roof to see if the stains were indeed coming from a problem associated with the roof that your company had installed and, if so, what the source of the problem or problems was. The only "good" thing about the situation was that winter break had just started, so this could be done without disturbing classes.

THE INVESTIGATION

Starting your investigation in the interior of the school, you removed a small portion of the ceiling in a storage closet that had stains on the ceiling and on a wall. You had thought about removing a portion of the ceiling in the playground entry, but with all the weight and water from the ice dams there, you figured it would make more sense to investigate the other areas of concern first. Upon removal of the ceiling portion, the facility manager's accusations were confirmed—the moisture appeared to be coming from the roof or roofing materials.

You then proceeded outside, got up on the roof, and removed a small portion of the vented nailbase material. This is when the nightmare really became a reality.

NAILS

To your surprise, you found rust on the ends of the roofing nails, as condensation always forms on the coldest, most dense material; and they are in direct contact with the outside air. Although there are many horrible conditions associated with roof condensation, the disruption of the roof nailing is possibly one of the worst conditions as far as the building goes. If the nails are deteriorated, the roof needs to be removed and replaced.

SHEATHING

The problems did not stop there, however. There were also small blackish stains on the roof sheathing at the nail locations. Mold was starting to form. If the problem wasn't fixed but went on undiscovered, there would not only be small stains on the sheathing, but the whole thing would become black, wet, and delaminated.

AIR SPACE

If there is insufficient air flow, it will not only cause ice damming, but it will also allow the formation of moisture within the air space of the vented nailbase system in the form of condensation. This occurs when water vapor cools and becomes a liquid. Condensation moisture can create an environment suitable for mold and mildew growth.

The formation of mold and mildew was exactly what was found. It is a huge health concern for anyone breathing it in, especially the children that attend the school, pregnant women, and anyone with allergies, asthma, or a weakened immune system.

INSULATION

The insulation was not only damp from all the condensation, but there was a small gap in the insulation between the panels in the square you removed. After cutting out a couple more small squares of the roof in different areas, you discovered similar problems in all of them.

The roof needed to be removed and replaced. If it were not, the school would continue to have heating and cooling loss through the gaps in the insulation, and the R-value would drop due to the moisture.

Condensation can decrease the effectiveness of insulation and, over time, can cause significant damage. If condensation and moisture issues go untreated, they can destroy the entire roof structure. That is why it can cost from ten cents to ten dollars or more per square foot to fix condensation problems, depending on how long the issue has been going on before it is discovered and corrected.

VAPOR RETARDER

Vapor retarders are intended to minimize air leakage and reduce migration of moisture. The National Roofing Contractors Association (NRCA) recommends that a vapor retarder be used in all areas of the country where the average January temperature is below 40°F, including the Midwest. The exception to this rule would be in the far southern portion of the country where a vapor-permeable air barrier system is recommended to prevent accumulation of moisture within the system.

THE FIX

It was determined that in order to fix the many underlying issues the school was experiencing, the roof would need to be replaced again. The architect and consultant did some additional research on the amount of ventilation needed for the school's building design. After further investigation and contacting the vented nailbase manufacturer, they used an online ventilated roof system calculator to determine that the school really needed a 2-in. air space in the vented nailbase system to help prevent ice dam and condensation issues. They also learned that they should do two layers of insulation—a small base layer and the layer in the vented nailbase system—with staggered joints to prevent heat loss and condensation buildup. However, all of this would not ultimately fix their issues. As Wayne Tobiasson concluded, ventilation is a key factor. They needed to fix the eave intake and the ridge exhaust. With a little additional research, they were able to find the perfect ventilation products that were designed to the exact ventilation requirements for the school and their design.

Because of the way you handled the situation, in addition to the fact that the moisture issues were not all the fault of your installation crew, you were actually called back and awarded the reroof work and were able to restore the credibility of your company.

Marlea R. Knox, CDT

Marlea Knox joined the Metal-Era team in April of 2007 to support the newly created Airflow Solutions product division. She serves as a technical resource for customers and design professionals, providing project management services and ensuring the best design practices are followed and that projects run smoothly. Marlea earned her associate's degree in architectural technology from Madison Area Technical College. As an active member of the Construction Specifications Institute (CSI), she earned her Construction Documents Technologist (CDT) certificate in 2008.

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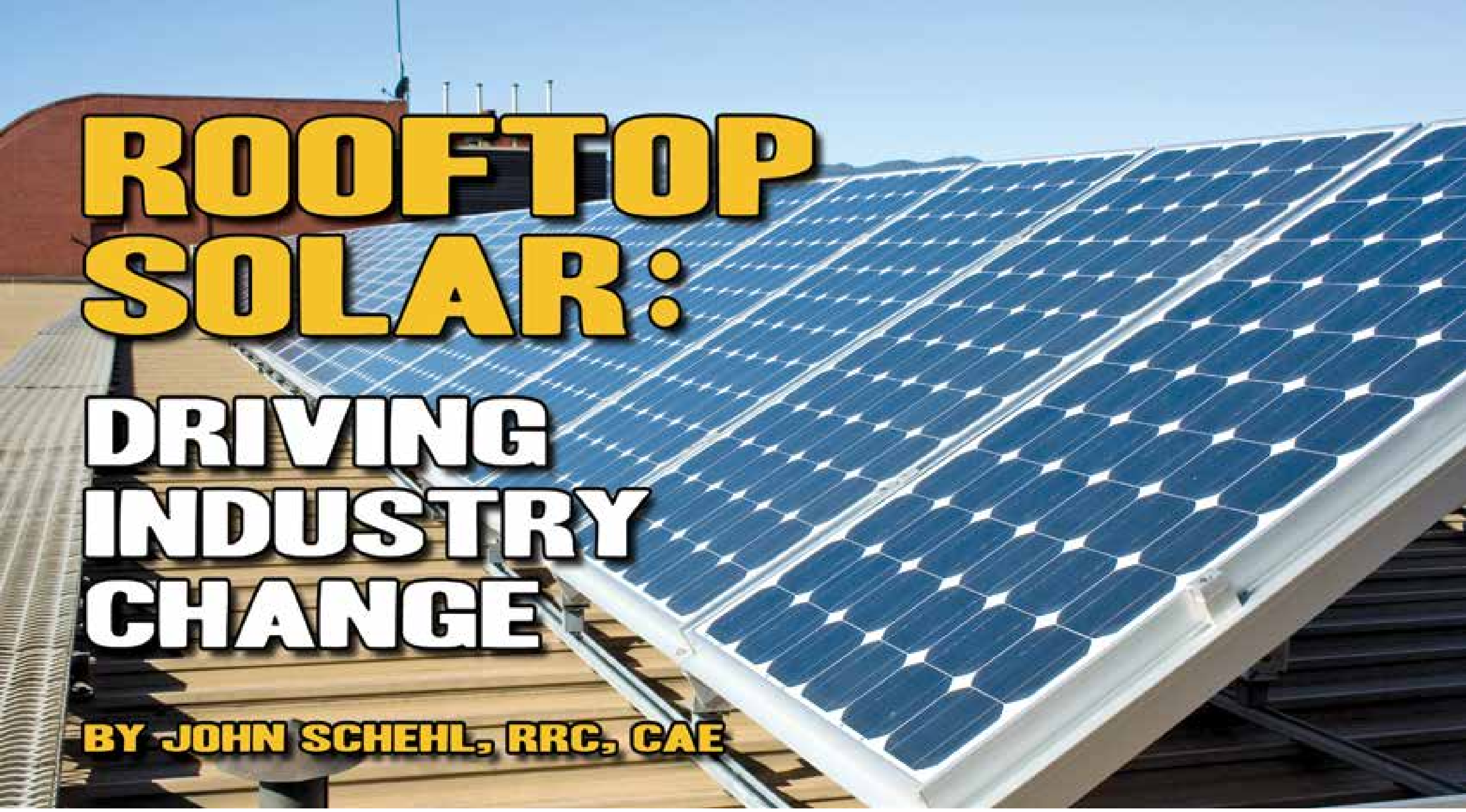
BY JOHN SCHEHL, RRC, CAE



The U.S. solar photovoltaic (PV) marketplace is often called the "wild, wild west of PV." While this statement may be hyperbole, it helps explain why many roof consultants and roofing contractors hesitate stepping into this frontier. Making business decisions about whether—or how—a roofing professional should engage rooftop PV systems can be intimidating and difficult. This article presents data and other information intended to help roofing professionals make informed business decisions.

THE SOLAR MARKETPLACE

Before investing in the PV industry, you may ask whether the demand for solar is sustainable or just another industry fad, especially during a slow economy. Does rooftop solar offer realistic business opportunities, and is it here to stay? Am I realistically qualified to pursue these opportunities? The answers to these questions may be found by looking at data and trends and then forming reasonably informed assumptions.

PV DEMAND IN THE U.S.

Green Tech Media (GTM) conducts market research on behalf of the Solar Energy Industries Association (SEIA). According to a recent GTM report, the U.S. solar industry grew in terms of total installed megawatts (MWdc) by 109% in 2011 compared to 2010 (887 MWdc were installed in 2010, and 1,855 MWdc were installed in 2011).

How did PV installations track for 2012? The most recent GTM data, published in September, show PV system installations in the U.S. grew 37% for residential and 24% for commercial properties during the first two quarters of 2012 compared with the same period in 2011. GTM forecasts 3.2 GW of PV will be installed in the U.S. in 2012, up 72% from 2011 (see *Figure 1*). A favorable trend is emerging.

April Saylor, digital outreach strategist at the U.S. Department of Energy's (DOE) Office of Public Affairs, says, "Developers are likely to install about 3,300 megawatts of solar panels in 2012—almost twice the amount installed last year" (http://energy.gov/articles/solar-demand). This supports the data presented by GTM.

The U.S. solar market has nearly doubled in MWdc installations every year since 2005, and it is forecast to install 8,200 MWdc in 2017 (see *Figure 2*).

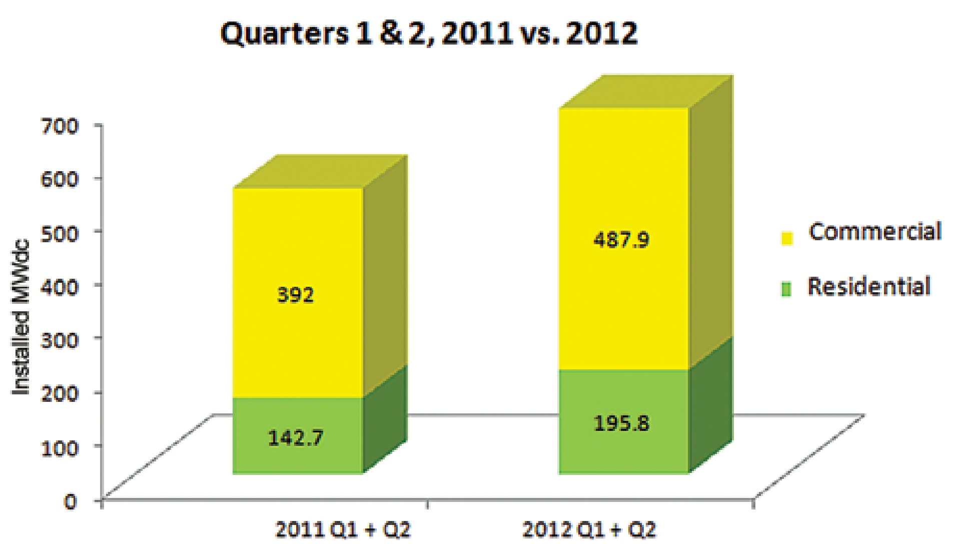


Figure 1 – PV system installations are increasing in spite of the slow economy.

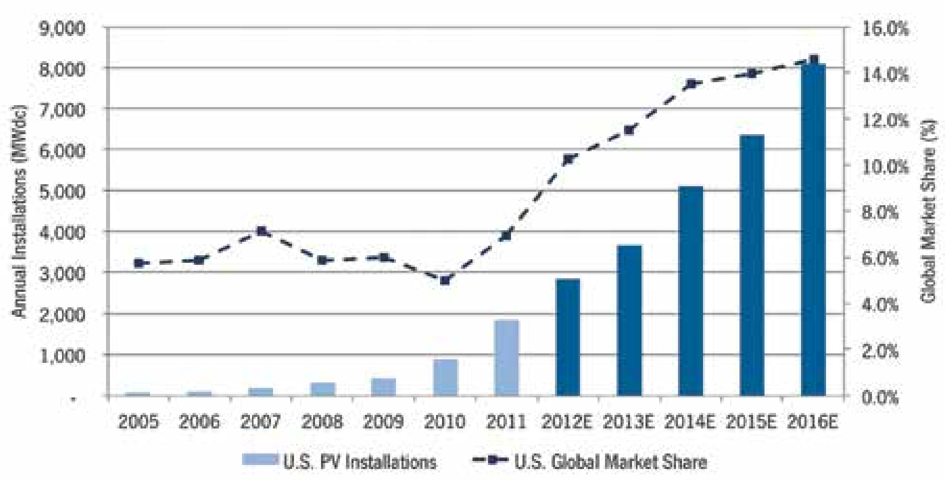


Figure 2 – Projected U.S. solar market growth, 2012 through 2017.

It should be noted that no data exist specifically segregating or aggregating roof-mounted PV system installations. But GTM's data at least segregates utility-scale solar installations, and the remaining residential and commercial installation data tell a compelling story of continued and sustainable growth. It is reasonable to assume, after seven years of data supporting consistent U.S. solar market growth despite a poor economy, that roof-mounted PV business opportunities will also continue to grow.

PV INSTALLATION JOB GROWTH

The 2012 National Solar Jobs Census, released on November 16, 2012, by the Solar Foundation, an independent research organization, tracks steady growth of the U.S. solar job market during the past 12 months. Now in its third iteration, the census finds the solar industry is one of the fastest-growing job markets in the country—employing more than 119,000 skilled solar workers and growing at an annual rate of 13.2% (http://thesolarfoundation.org/research/national-solar-jobs-census-2012).

Reacting to this report, Minh Le, U.S. DOE's acting solar program manager, states, "[That] U.S. solar industry jobs continue to expand at a double-digit annual growth rate shows that efforts to grow the solar market and make solar energy more accessible to all Americans are working. The solar industry continues to be an engine of job growth—creating jobs six times faster than the overall job market." DOE anticipates this robust growth to continue. Projections from its SunShot Vision Study, an in-depth assessment of the potential for solar technologies to meet a significant share of electricity demand in the U.S. during the next several decades, estimate that by 2030, more than a quarter million highly skilled solar workers will contribute to the U.S. economy (http://www1.eere.energy.gov/solar/pdfs/47927_executive_summary.pdf). To help meet the need for a growing number of solar professionals, DOE is expanding its Solar Instructor Training Network program to connect returning veterans to this high-growth sector of our economy.

These solar job figures reflect a stronger demand for clean-energy generation, a steady decline in solar-hardware costs, and strategic investments made by the DOE in solar research and development over many years. Independent analysis has shown investments made by DOE's Office of Energy Efficiency and Renewable Energy have accelerated the growth of the U.S. solar industry by an estimated 12 years. Matthew Loveless, data integration specialist from the DOE's Office of Public Affairs, says, "A growing solar industry presents a tremendous economic opportunity for the United States, and that is why the Energy Department's SunShot Initiative supports America's best solar energy entrepreneurs and innovators."

The data overwhelmingly indicate work opportunities in the U.S. solar market will continue to grow for many years to come, and it is reasonable to assume the rooftop solar workforce will also increase. So, what are the business opportunities for roof consultants and roofing contractors who choose to enter the solar market?

ROOFING PROFESSIONALS AND PV

For most roofing professionals, there are four roles one may choose to play in the wild, wild west of PV. These include:

1. Be a subcontractor who provides roof system repairs or installation in conjunction with a roof-mounted PV system installation under a solar-PV integrator.
2. Be a subcontractor who performs all aspects of roof and solar-PV system repairs or installation under a general contractor.
3. Be a prime contractor who performs all aspects of roof and PV system installation or repairs.
4. Supervise the installation of roof-mounted PV systems being performed by others to help ensure roof system integrity is maintained.

The author has found that most roof consultants and roofing contractors are not qualified to design rooftop PV systems, to install any PV system components for which they are not licensed, or to integrate a PV system into any other building system (e.g., electrical system) other than a roof, though they may employ qualified staff or subcontract with others to perform these functions. Examples of other qualified individuals include professional electrical engineers performing PV system designs and licensed electricians integrating a PV system with a building's electrical system. PV system integrators typically do not understand the issues of integrating PV and roof systems, nor are they generally familiar with the best practices for protecting and maintaining the integrity of an existing roof system during rooftop PV system installations.

Roof consultants and roofing contractors may be the most efficient and effective providers of roof-mounted PV system installation services. Why? Simply put, rooftops are their domain of professional practice. Roofing professionals have the unique qualifications and experience in the critical phases of a roof system's life cycle, including design, installation, administration, and maintenance. They may offer the highest value proposition for building owners as a prime vendor for roof-mounted PV system installation projects. Advantages roofing professionals offer to building owners versus other solar contractors or integrators may include:

- Experience and technical knowledge to more accurately assess rooftop conditions and project existing equivalent system life (matching roof and PV system life)
- Familiarity with roofing-related building codes and standards

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Jason Loyet, founder of Clean Power Design, St. Louis, MO, agrees: "[Roofers and roof consultants] have greater advantages over electrical contractors and other solar installers to install rooftop PV. Doing solar is a less steep learning curve for them. And they typically are better at marketing and building trusting relationships with owners. They already have these great relationships and are a natural choice for doing solar." Loyet adds, "I'm surprised more roofers are not doing solar. They are the natural PV installers of the future."

In fact, the number of roofing professionals engaged in PV work is increasing. In June of 2010, the National Roofing Contractors Association (NRCA) started tracking a member category of work for PV, and 77 (2.1%) members initially reported they install roof-mounted PV systems. This number increased to 216 (6%) by August of 2011, and the current number is 273 (7.2%).

The bottom line for a building owner is that a roof system must perform its primary function—keeping a building weatherproof—regardless of other building systems or components that may be installed.

ROOFING INDUSTRY PROFESSIONALISM

The depth and breadth of expertise required to design, install, and maintain successful roof systems has grown significantly over the last four decades. A good expression of this truth is the growth of the technical *Roofing Manual* published by the NRCA. The first edition of the manual, published in 1970, was 112 pages and covered a single roof system. Today, the same manual is nearly 1,600 pages, comprising four volumes covering 14 major roof system types and includes technical recommendations on roof decks; air barriers and vapor retarders; thermal insulation; and specialty topics, including vegetative and solar-PV systems, roof system accessories, architectural metal flashings, and condensation control. The guidelines and recommendations contained in the *NRCA Manual* represent the most comprehensive collection of industry consensus best practices on which roofing professionals, building owners, and the public rely.

Further, a number of steep-slope shingles and tiles and low-slope membranes with fully integrated energy-producing PV components have entered the market in recent months. These products are engineered to function as weatherproofing roof systems, to produce energy, and are designed for installation by roofing professionals.

Considering the parallel growth of applicable building codes and standards, it is fair to say professionalism is the operative word for anyone performing construction of any kind that involves a roof system.

ROOF-MOUNTED PV PROFESSIONALISM

What is "professionalism," and how does a building owner know if a roofing professional is qualified to install a roof-mounted PV system?

Work in all industries has become more complex; and the demand for professional, specialized credentials has increased. The word "professional" is defined as someone "engaged in one of the learned professions" (http://dictionary.reference.com/browse/professional). The key word here is "learned." Then, how does a building owner know if someone claiming to be professional has adequately learned the highly specialized work of roof-mounted PV systems?

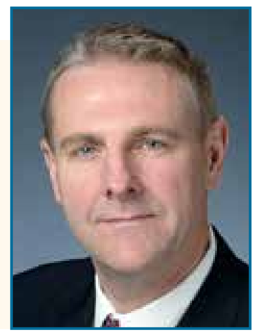
The roofing industry has created an industry-specific certification for professionals interested in pursuing roof-mounted PV work. The Certified Solar Roofing Professional (CSRP) credential is a nationally recognized personnel certification built to conform to the rigorous consensus-based and process-driven standards set forth by the International Standards Organization (ISO) document ANSI/ISO/IEC 17024, titled "Conformity Assessment – General Requirements for Bodies Operating Certification of Persons." The CSRP program is independently administrated by Roof Integrated Solar Energy (RISE), an organization incorporated in 2010 and founded by the Center for Environmental Innovation in Roofing and the NRCA to establish the standards of knowledge, skills, and personal abilities (KSAs) for individuals who install roof-mounted PV systems. Earning the CSRP credential is confirmation that an individual indeed possesses the KSAs to work with roof-mounted PV systems. CSRPs do not design PV systems, nor do they try to perform the work of professional electricians. Rather, they possess the unique KSAs specific to the installation of PV systems on roofs. CSRPs use the credential's mark to differentiate them in the PV marketplace and position themselves as experts on roof-mounted PV installations.

Prospective CSRP candidates realize there is much to learn about roof-mounted PV systems. The topics someone needs to know to succeed at earning the CSRP are presented in the RISE document, "Job Task Analysis (JTA)," which can be found on the RISE website at www.riseprofessional.org/roofing-certification.shtml. The most common question we receive from RISE candidates is, "Where do I get the training?" There are professional development opportunities for consultants and contractors who want to grow their KSAs in rooftop solar. RISE provides a self-study guide, developed in partnership with Penn State University; this document is also available on the RISE website. NRCA has developed two additional study resources: an online self-paced study course, titled "Photovoltaic Roof System Installations"; and a one-day live workshop, "Photovoltaic Roof Systems: Energizing Your Business." Both courses address the unique KSAs specific to the installation of rooftop PV and are available through NRCA at www.nrca.net/rp/education/nrca/.

Professional credentials are an effective tool to increase professionalism and drive change in the roofing industry. Like many early trailblazers of the Western frontier, some embraced the challenges and moved forward to create historic change, while others chose to settle back in their comfort zones, only to be left in the dust. As the roof-mounted PV market continues to grow, so will the business opportunities for roofing professionals.

John Schehl, RRC, CAE

John Schehl is the executive director of Roof Integrated Solar Energy (RISE) Inc. He has been active in the roofing industry since 1972, including serving 14 years as education staff for the NRCA and 25 years as a residential and commercial roofing contractor in the Chicago marketplace. John holds a master's degree in human resource development and is a Certified Association Executive and a Registered Roof Consultant.



NLBMDA Announces "Dealers Helping Heroes" Program

The National Lumber and Building Material Dealers Association (NLBMDA) has made public its "Dealers Helping Heroes" program to help injured military veterans renovate their houses or build new ones.

As the most severely wounded veterans leave the hospital and transition to civilian life, they are often in desperate need of assistance in remodeling, renovating, or building a home that will work for their particular disabilities. However, each receives only $7,000 for a remodel and $64,960 for building a new home from the federal government.

"This industry wants to support our country's military veterans, and one way we'll help is with the Dealers Helping Heroes program. The Yellow Ribbon Fund and the Helping a Hero Organization have some great ideas on how construction supply businesses can make an impact in the lives of military families, and we look forward to working with them," said NLBMDA Chairman Chuck Bankston.

When a veteran is ready to transition home, his or her name is added to a master list maintained by Helping a Hero (www.helpingahero.org). Participating state/regional building material associations will receive a biweekly list of veterans looking to transition home and where they are transitioning to. The state/regional association will identify a local dealer willing to "adopt" the veteran and provide whatever assistance they can to help them with the building project. Helping a Hero will contact the dealer to further discuss the needs of the local veteran, answer any questions, and define the parameters of the project. Once the dealer is fully on-board, Helping a Hero will pair the veteran with the dealer and work with them to complete the home project.

"These American heroes have given so much to our country. The Dealers Helping Heroes program is a small way for the building material industry to thank them for their service and sacrifice on behalf of all Americans," said NLBMDA President Michael O'Brien.

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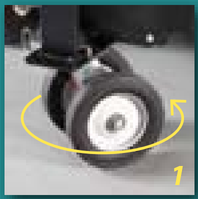

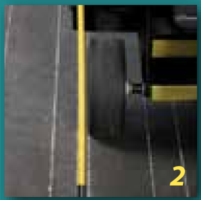

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CRRC ANSI/CRRC-1-2012 Standard Received Approval

The American National Standards Institute (ASTM) and the Cool Roof Rating Council (CRRC) have received final approval of their ANSI/CRRC-1-2012 standard following a two-year public-review process.

ANSI/CRRC-1 outlines policies for the measurement of initial and aged solar reflectance as well as thermal emittance values of roofing products. It was adapted from the CRRC's *Program Manual* and describes sample preparation and test procedures to ensure consistency in preparation and measurement of roofing properties. The ANSI/CRRC-1 standard was originally accredited on November 16, 2010.

– CRRC

USGBC Lists Top New LEED States

The U.S. Green Building Council (USGBC) has released its annual list of the top ten states for new LEED certifications for 2012, based on square footage per resident. They are: Washington DC, Virginia, Colorado, Massachusetts, Illinois, Maryland, New York, Washington, California, Texas, and Nevada.

– USGBC

2012 Roofpoint Excellence in Design Awards

The Center for Environmental Innovation in Roofing (Center) announces the recipients of the 2012 RoofPoint™ Excellence in Design awards. This year's award winners were selected among nearly 100 projects submitted for consideration and evaluated based on the mission and criteria of RoofPoint.

RoofPoint is a voluntary, consensus-based green rating system developed by the Center to provide a means for building owners, roofing contractors, and designers to select roof systems based on long-term energy and environmental benefits. With the launch of RoofPoint, the Center now recognizes design excellence through the RoofPoint program.

The 2012 RoofPoint Excellence in Design award contest recognizes design excellence in 11 categories. Award recipients best exemplify the spirit and requirements of specific RoofPoint credits and demonstrate significant leadership in advancing the awareness and application of sustainable roofing. The 2012 award winners are:

- **Excellence in Energy Management:** DERBIGUM Americas, Inc. for Bayer CropScience – Kansas City, MO
- **Excellence in Materials Management:** Sika Sarnafil for GM Aftersales Warehouse – Lansing, MI
- **Excellence in Water Management:** Carlisle Construction Materials for Brooklyn Navy Yard Building 3 – Brooklyn, NY
- **Excellence in Life Cycle Management:** Hutchinson Design Group, Ltd. for four projects exemplifying high levels of durability and energy efficiency
- **Excellence in Innovation:** Tremco Roofing and Building Maintenance for M.D. Anderson Cancer Center Labyrinth Garden Roof – Orlando, FL
- **Excellence in Reroofing:** Benchmark, Inc. for Aviall Services – Dallas, TX
- **Global Leadership:** Firestone Building Products for Lowe's, Etobicoke – Toronto, Canada
- **Community Leadership:** Porter Roofing Contractors, Inc. for 18 projects in Tennessee and Alabama
- **Private Sector Leadership:** D.C. Taylor Co. for TD Ameritrade Headquarters – Omaha, NE
- **Public Sector Leadership:** United Materials, LLC for nine federal sector projects in Denver, CO
- **Advancing Sustainable Roofing:** Firestone Building Products for Bridgestone Americas Technical Center – Akron, OH

— Center for Environmental Innovation in Roofing

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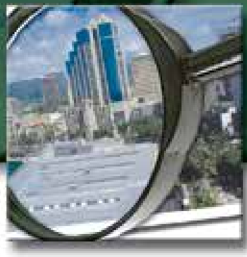


Housing Starts Up; Construction Workers Leave Industry

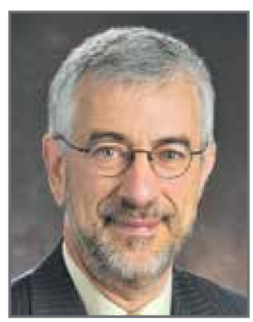
By Ken Simonson

The producer price index (PPI) for inputs to construction—a weighted average of the cost of all materials used in construction plus items consumed by contractors such as diesel fuel—rose 1.3% year-over-year through December, compared with increases of more than 5% in 2010 and 2011, according to the Bureau of Labor Statistics (BLS). For the first year since 2008, the prices that contractors said they would charge for new nonresidential buildings and subcontractors' prices kept pace with input costs. The PPI for new warehouse construction was flat in December and rose 2.6% over 12 months; new industrial buildings, 0 and 1.4%, respectively; offices, 0.1% and 1.4%; and schools, 0 and 1.1%. The PPI for new, repair, and maintenance work on nonresidential buildings by roofing contractors rose 0.1% in December and 2.4% over 12 months; plumbing contractors, 0 and 1.0%; electrical contractors, 0 and 0.5%; and concrete contractors, -0.3% and -0.1%.

Housing starts in December soared 12%, seasonally adjusted, in December over the previous month, and 37% from a year earlier, the Census Bureau reported. For all of 2012, starts leaped 28%. Single-family starts climbed 8.1% for the month, 18% from the year-ago month, and 24% for the full year. Multifamily starts jumped 20%, 91% and 37%, respectively. Building permits—a generally reliable guide to short-term future starts—rose 0.3%, 29%, and 30%. Single-family permits were up 1.8%, 27%, and 23%. The more volatile multifamily permits fell 2.1% for the month but rose 32% from a year ago and 45% for all of 2012.

Nonfarm payroll employment increased by 155,000, seasonally adjusted, in December, and 1,835,000 (1.4%) in 2012, the BLS reported. The unemployment rate was 7.6%, not seasonally adjusted (7.8%), down from 8.3% a year earlier. Construction employment totaled 5,564,000, seasonally adjusted, an increase of 30,000 from November—the largest one-month gain since January 2011—but was up only 18,000 (0.3%) from December 2011.

Total hours worked in construction increased by 2.7% over the year, implying that contractors preferred to lengthen working hours before hiring new workers. The unemployment rate for former construction workers dropped from 16.0% (1,327,000), not seasonally adjusted, in December 2011 to 13.5% (1,105,000) in December 2012, suggesting that most of the 222,000 workers who are no longer listed as unemployed were hired by other industries, returned to school, retired, or quit the labor force.



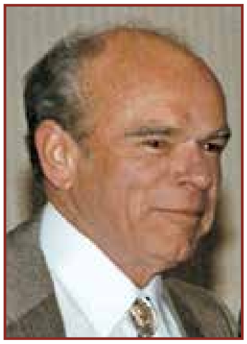
Ken Simonson

This series on the economy and its impact on the construction industry is published monthly in Interface. *This month's column was prepared by Kenneth D. Simonson, chief economist for the Associated General Contractors of America (AGC). Simonson is also the 2012-13 president of the National Association for Business Economics. He may be reached at simonsonk@agc.org.*

Industry News

To submit an industry news item to *Interface,* e-mail it to kammerman@rci-online.org or mail it to RCI, *Interface* Journal, 1500 Sunday Drive, Suite 204, Raleigh, NC 27607. Note: News must fit journal requirements in order to be published.

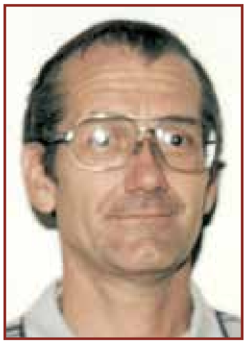
James Magowan Dies



James E. Magowan, FRCI

James E. Magowan, FRCI, president of RCI from 1990 to 1991 and a former RRC, died November 11, 2012, at his home in Amboy, WA, at the age of 86. Instrumental in the formation of the RRO exam, he also chaired RCI's Crisis Intervention Committee and was named an Emeritus member of RCI in 1998. Jim started as a journeyman roofer and formed his own consulting firm in 1981, Roofing Information Center, in Dublin, CA. (For a tribute to Jim, see the March issue of *RCItems*.)

David H. Siple Passes On



David H. Siple, FRCI

David H. Siple, FRCI, and a former RRC, died December 19, 2012, in Florida at the age of 77. He had been a member of RCI since 1988, teaching many educational courses and being named a member of the Jury of Fellows in 2003. After earning a BS in education from Greenville College, Greenville, IL, he went on to receive a MA in education from Michigan State University. He started his career in the industry as part owner of construction and masonry companies in Michigan before becoming a principal with Ribble & Associates in Clearwater, FL. Most recently, he was employed by Accurate Roof Consultants in Clearwater.

GZA GeoEnvironmental to Relocate

GZA GeoEnvironmental, an environmental and geotechnical consulting firm, is relocating to a new 50,000-sq.-ft. headquarters at 249 Vanderbilt Avenue in Norwood, MA. GZA employs more than 550 engineers, scientists, and technical support staff in 25 offices around the U.S. The firm was founded in 1964.

GZA GeoEnvironmental relocates headquarters.

Kalinger Wins Cullen Award

Peter Kalinger, technical director at the Canadian Roofing Contractors' Association (CRCA) in Gloucester, ON, has been presented with the William C. Cullen Award by ASTM International Committee D08 on Roofing and Waterproofing. The award was given for outstanding contributions to international standards for roofing and waterproofing. He has been a member of the committee since 1994. Kalinger has been with the CRCA since 1993. Prior to that, he was director of technical services at Batten Sears & Associates Consultants in Ottawa. He is a member of Construction Specifications Canada, the International Council for Research and Construction, the RILEM, and RCI.

EagleView Merges With Pictometry

EagleView Technologies, provider of automated 3-D measurement technologies, and Pictometry International, provider of geo-referenced aerial image capture and visual-centric data analytics, have merged their businesses. Chris Barrow, EagleView CEO, will lead the management team as president and CEO, while Pictometry's CEO, Rick Hurwitz, will exit the business. A board of directors has been built with three executive leaders from each of the companies. The company will operate with offices in Bothell, WA, and Rochester, NY.

BASF Opens Center in Toronto

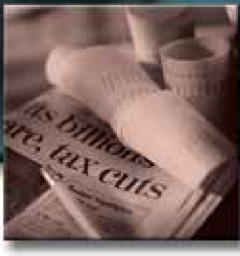
BASF Corp.'s Construction Chemicals division has opened a new construction center in Toronto, ON. The facility offers on-site customer service and support, manufacturing and warehousing capabilities.

GAF to Open Plant in Cedar City

GAF has announced plans to open a combined polyisocyanurate (ISO) and thermoplastic polyolefin (TPO) manufacturing facility in Cedar City, UT. This expands the company's North American single-ply network to three ISO operations and three TPO operations. The plant is between Salt Lake City and Las Vegas and includes an existing building with more than half a million sq. ft. of space. Operations should begin in 2014 and create 50 new jobs.

CertainTeed Plans New Shingle Plant

CertainTeed Corporation announced plans to open a new asphalt roofing shingle plant servicing the central U.S. The new facility, expected to employ 125 people, will be its first Greenfield roofing plant since the company built its Oxford, NC, plant in 1978 (currently the largest shingle plant in the world). CertainTeed operates ten asphalt shingle plants, one low-slope roofing facility, and three stand-alone granule production plants in the U.S.



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Kirby to Cochair ASTM D08.24

James R. Kirby, AIA, vice president of sustainability at the Center for Environmental Innovation in Roofing, has been named cochair of ASTM Committee D08.24 on Sustainability, a subcommittee of the ASTM Committee on Roofing and Waterproofing.

Seaman Honored

Richard N. Seaman, chairman of Seaman Corporation, received an Honorary Lifetime Membership from the Industrial Fabrics Association International (IFAI) in Boston, MA, at the IFAI Expo Americas 2012. Seaman Corp., based in Wooster, OH, is a coated-fabric manufacturer. The company received the 2012 "Perfect Engine" award from TBM Consulting Group, recognizing the company's commitment to a "continuous improvement philosophy and success with 'lean' enterprises."

ABC U.S. Acquires E.S. Products

Altenloh, Brinck & Co., U.S. Ins. (ABC U.S.) has acquired E.S. Products, a specialty roof fastener company serving the low-slope roof deck market for nearly 60 years. The acquisition allows ABC U.S. to broaden its TRUFAST roofing fastener offerings. The E.S. Products name will be retained by ABC U.S. and will continue to be manufactured at the company's Bristol, RI, facility. Its Atlantic Beach, FL, sales office will also be retained. ABC U.S. is part of the ABC Group, headquartered in Ennepetal, Germany, and founded in 1823.

Hours Shortened for Full-Time Employment

New regulations have shortened full-time employee status to 30 hours per week.

Calendar of Events

Red print: RCI Educational or Registration Opportunity
Blue print: RCI Leadership Event
Green print: RCI Region or Chapter Meeting
Black print: Industry Event

Bold-faced items indicate two or more RCI events scheduled consecutively for convenience.
Calendar subject to change without prior notice.
Visit **www.rci-online.org** for schedule updates.

MARCH 2013

3-6 SWRInstitute Winter Technical Meeting
Scottsdale, CA
Info: swrionline.org

14-19 RCI International Convention & Trade Show

14 RCI Board of Directors meeting

15 RRO, RRC, RWC & REWC exams *(applications due 12/17/12)*

16 Region meetings

18 RCI Annual Mtg. of Members

19 RCI Board of Directors meeting
Orlando, FL

21 Canadian Prairies Chapter meeting

26-28 ABAA trade show
Chicago, IL
Info: airbarrier.org

27 Puget Sound Chapter meeting
Seattle, WA

APRIL 2013

18 SoCal golf outing
Orange County, CA

18-19 Metal Roofing
Pensacola, FL
Del. by RCI N. Gulf Coast Chapter
Info: Ken Leggett, 850-607-7328

19 Ontario Chapter workshop

25-26 Rooftop Quality Assurance
Langley, BC
Delivered by RCI Western Canada Chapter
Contact: John Pitre, 604-909-7777 or www.rciwesterncanada.org

27 RRO exam *(app. due 1/28/13)*
Langley, BC

MAY 2013

2 Puget Sound Chapter meeting
Seattle, WA

2 Great Lakes Chapter meeting

3 Region I meeting
Woburn, MA

9-10 Professional Building Consulting
Seattle, WA
Del. by RCI Puget Sound Chapter
Info: Eric Weller, 206-972-3211 or www.rcipugetsound.org

9-10 Exterior Walls Technology & Science
Toronto, ON
Delivered by RCI Ontario Chapter
Info: Joel Dandelé, 416-847-9153 or www.rci-ontariochapter.ca

10 Chicago Area Chapter meeting
Oak Brook, IL

10 Florida Chapter sporting clays
Land O'Lakes, FL

JUNE 2013

4-5 Roof Technology & Science I
Columbus, OH

6-7 Roof Technology & Science II
Columbus, OH

6-7 Professional Building Consulting
Mt. Laurel, NJ
Delivered by RCI Delaware Valley Chapter
Info: Jesse Torres, 212-760-2540

8 RRC exam *(app. due 3/8/13)*
Mt. Laurel, NJ

9-13 Western States Rfg. Contr. Conv.
Reno, NV
Info: wsrca.com

12 Region IV meeting
Reno, NV

14 *REWC app. due for 9/14/13 exam*

20-22 AIA National Convention
Denver, CO

21 *RRO app. due for 9/21/13 exam*

JULY 2013

5 *RRC app. due for 10/5/13 exam*

12 *RWC app. due for 10/12/13 exam*

TBD Exec. Comm. summer meeting
TBD

17 Puget Sound Chapter meeting
Kent, WA

AUGUST 2013

2 Region II meeting
Atlanta, GA

9 *RRO app. due for 11/9/13 exam*

16 *RRO app. due for 11/16/13 exam*

26-27 Metal Roofing
Atlanta, GA
Delivered by RCI Georgia Chapter
Info: Joseph Morgalis, 404-256-2388 or www.rcigeorgia.org

ADVERTISERS' INDEX

Would You Look at That!

Rocky & Co. Were Busy

Managers for a major department store client in Louisville, KY, called 18 months after we reroofed their store with fully adhered 60-mil EPDM, complaining that there were "roof leaks on the lower roof."

We investigated and found 16 holes.

The cause? **RACCOONS.**

Submitted by Gary L. Mitchell, RRC, RRO, CCCA, CEI
Arnold & Associates, Inc.
Addison, TX

Readers running across situations that would catch the attention of other building envelope consultants are asked to submit representative photographs and a maximum 150-word summary to Kristen Ammerman, Director of Publications, "Would You Look at That!" column, RCI, 1500 Sunday Drive, Suite 204, Raleigh, NC 27607 or via e-mail to kammerman@rci-online.org.

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