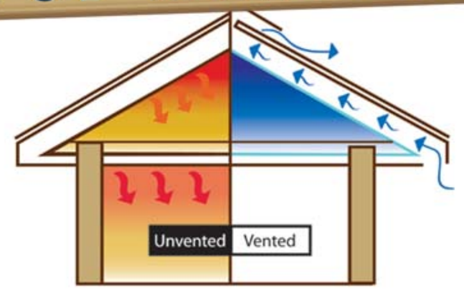
COMMERCIAL ROOF VENTILATION:

A CAREFUL BALANCING ACT



By Tony Mallinger
and Angela Arndt

Common wisdom states, "Prevention is better than cure." This is certainly the case regarding roof ventilation. It is much easier to design a roof from the beginning that provides the needed amount of ventilation in order to avoid the various issues associated with poor airflow. Among those issues are ice dams, moisture buildup, leaks, premature shingle degradation, and increased heating and cooling costs (See *Figure 1*). All of these will cause the building owner additional problems and expense if not dealt with correctly.

However, when faced with aging or preexisting structures, these issues are often inherited, and it is up to others to diagnose and cure the issues by developing a ventilation strategy appropriate to the structure and the goals of the facility.

Regardless of whether the ventilation strategy is to address an existing issue or prevent a future one, it is important to understand how some simple solutions can have a big impact on the quality and life of a commercial roof. This is most easily demonstrated by examining several case studies that represent typical roof ventilation conditions across the country.

STONEBRIDGE CONDOMINIUMS

In 2008, the facilities at Stonebridge Condominiums in Snowmass Village, CO, were in need of a roof replacement. As the town's name implies, this area receives heavy snow loads, cool temperatures, and its buildings are prone to ice damming. With this in mind, the architectural firm of Theodore K. Guy Associates realized that proper roof ventilation would be critical to eliminating the threat of ice dams.

Research has shown that ice dams are not caused by the sun melting the snow directly but by the heating of the underside of the roof deck. This creates a temperature differential between the ridge and eave of the roof. Due to hot air's natural propensity to rise, the ridge is frequently warmer than the eave, melting the snow on the ridge. The melted water flows toward and refreezes at the cooler eave. Over time, this repeated process creates an ice dam or a buildup of ice at the eave.

Richard Roe, director of technical services at Atlas Roofing Corporation, notes, "Ventilation can prevent [ice damming] by promoting a cold roof. If the ventilation is adequate to keep the flowing air at a temperature below 32 degrees Fahrenheit, the

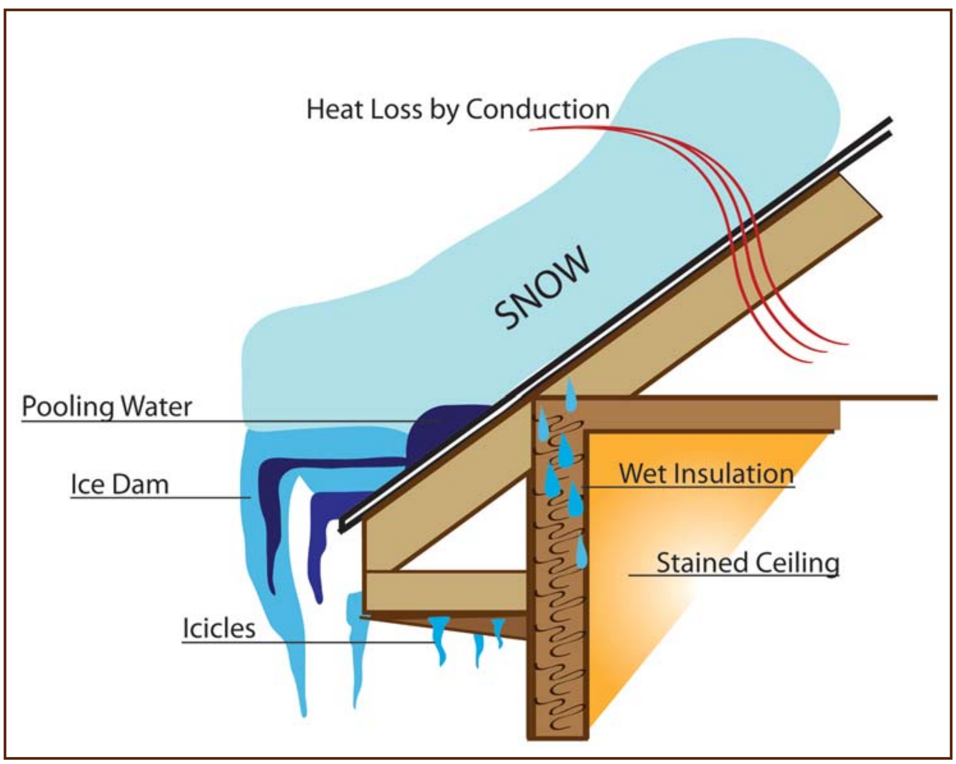


Figure 1 – A typical ice-damming detail.

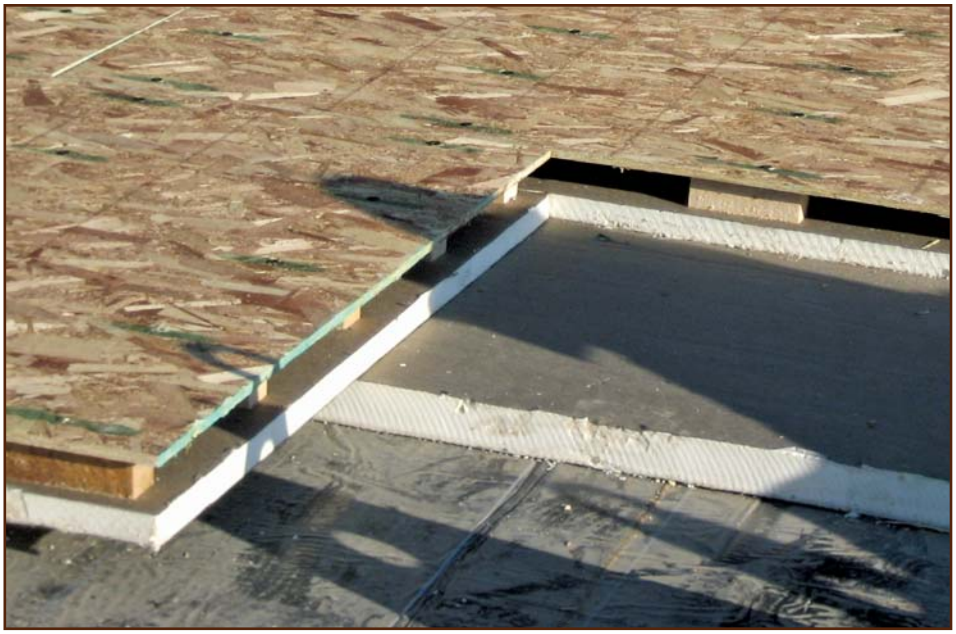


Figure 2 – A typical ventilated nail base.

snow on the roof will not melt. Ice damming will not occur.

"One common mistake is failing to balance the ventilation. The intake at the eave should provide adequate net free area (NFA), and it should be matched to the NFA of the ridge vent. If ventilating nail-base insulation is used, the NFA of that product must also match the eave intake and ridge exhaust."

A ventilated nail base is a product that combines a specified thickness of insulation with oriented strand board (OSB), separated by spacers to create the desired amount of air space (see *Figure 2*).

Ace Roofing Company partnered with the architect to create an effective ventilation strategy that properly balanced the airflow between the intake venting at the eave and the exhaust venting at the ridge. "It was important to mitigate the large ice dams and [create] a cold roof application. The use of [a vented nail base] with a vented fascia performed better than I expected," says Eddy Saueressig, vice president of Ace Roofing.

To create the right balance, Ace Roofing needed to make sure a large enough air space was provided. When using a ventilated nail base, frequently 1-in air gaps are specified; however, 1 in does not always provide enough space for the needed amount of air to travel through the system.

Tools based on independent research, such as Metal-Era's online calculator, can be of particular help in determining the ideal air space. When key variables such as the run, pitch, air gap, R-value, roof composition, and outside temperature are entered, the calculator easily graphs the air temperature from the eave all the way up to the ridge, predicting the point at which the airflow will lose effectiveness when using a 1-in, 1.5-in, or 2-in air space. The calculator utilizes multiple formulas in order to achieve its result. For a detailed discussion of these formulas and their relationship to each other, see the complete technical report.

After reviewing the roof conditions, it was determined that a nail base with a 2-in air gap would be required. The nail base requirements, when combined with the lengths of the eave and the ridge, meant that these vents would need to provide 24 sq in per linear ft NFA (see *Figures 3* and *4*).

This approach worked well for Stonebridge – so well, in fact, that when Saueressig was on the completed roof, he "could feel the air blowing out of the peak as if a fan were in there."

Figure 4 – The vented fascia integrates with the vented nail base to provide airflow for the roof system.

Figure 3 – A vented fascia with the appropriate NFA is installed at the eave.

Figure 5 – Commercial ridge vents were installed on each roof level of the building.

MARCY TOWN HALL

The town of Marcy, NY, was experiencing some problems on the roof of its town hall. Specifically, ice dams were causing leaks at the inside perimeter and in the valleys of the roof. There were increased demands on the building's heat and air-conditioning units, as well as premature deterioration of the roof materials.

McDonald & Monterose Architects was retained to address these issues. The firm found that the problems were largely due to exhaust ventilation at the ridge insufficient for the amount of intake at the eave. The extreme hipped roof further complicated the matter.

MacGregor Pierce, product and technical manager of Hunter Panels, remarks that "[not] balancing intake and exhaust functions" tends to be one of the most common mistakes made in roof ventilation.

Another issue to address for commercial structures is the degree of slope on the roof. Typically, commercial buildings have a much lower pitch than residential buildings, requiring products that can accommodate the increased ventilation demands of a lower-sloped roof, as was the case for Marcy Town Hall's 4/12 pitch.

"The steeper the slope, the more effective the chimney effect. Also, the distance the air flows affects the temperature of the air and its ability to keep flowing out the ridge vent. Both of these factors affect the size of the air space [and the] depth that is needed for effective ventilation," says Roe. "Low slopes and long runs…will require larger openings or deeper air-space dimensions, providing a larger net free area."

The longer runs of commercial buildings also impact ventilation strategy. "As this distance grows, the need for greater NFA grows. So, where a 1-in air space could be adequate for shorter runs, a wider air space

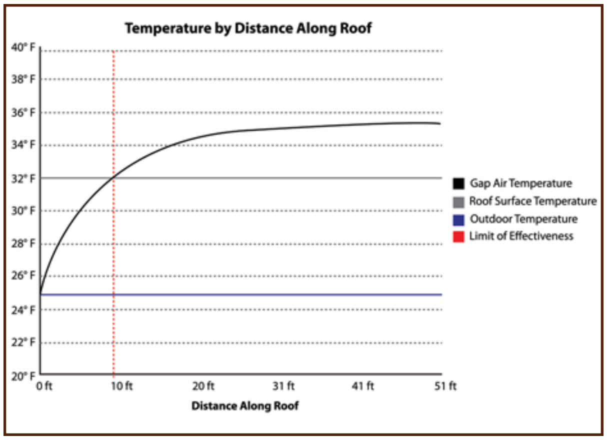


Figure 6 – This graph shows the results of Marcy Town Hall if a nail base with a 1-in air gap had been used. Note that the ventilation reaches its limit of effectiveness at approximately 9 ft and that the temperature of the air gap at the end of the run is 35.3°F, which is warm enough to promote ice dams.

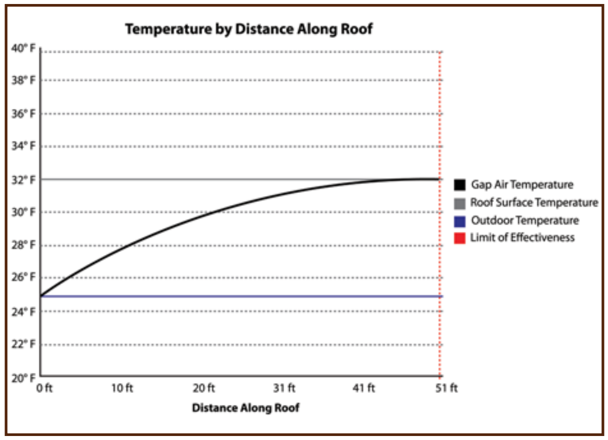


Figure 7 – This graph shows the results of Marcy Town Hall's using the nail base with a 2-in air gap. Note that the ventilation remains effective for the entire length of the run and that the temperature of the air gap is 32° F, which is cool enough to guard against ice dams.

(1.5 in, 2 in, or perhaps more) will be necessary to maintain airflow over these longer runs. Unfortunately, residential ridge vents are often installed on commercial projects that require more NFA than most residential vents can provide. If the eave intake and vented nail-base insulation have properly designed NFA, the residential ridge vent would in effect choke off the ventilation," Roe says. Using a commercial ridge vent that can accommodate larger air spaces will help address this issue (see *Figure 5*).

The architect's recommendations for Marcy Town Hall included removing the existing roofing material down to the steel deck and installing a cool-roof system. The cool roof includes a vapor retarder and two layers of insulation, one of which is a vented layer of insulation. The vented insulation has a 2-in air space with plywood over the spacers. Again, this increased air space was necessary to provide the system with enough room for the air to flow properly (see *Figures 6* and *7*). In addition, the design included a commercial-grade ridge vent and vented fascia that accommodated the larger NFA requirements of the project. Due to a challenging roof condition, a ridge vent for a sloped roof meeting a vertical high condition was also used.

Pete Monterose, partner and architect at McDonald & Monterose, opined that manufacturers are often a great technical resource in recommending the proper air space needed for a project. Specifically, he used "a [manufacturer's online] ventilation calculator to assist in establishing the sizes

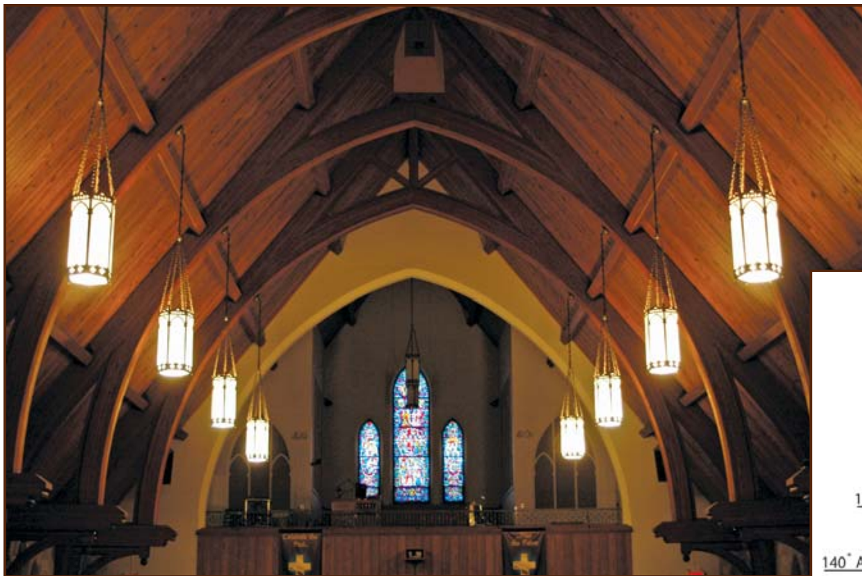
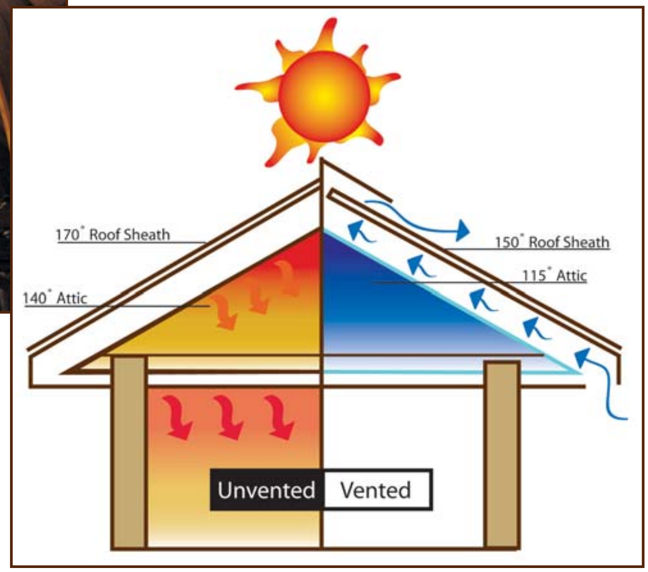


Figure 8 – Like many churches, St. John's has a large cathedral ceiling and, prior to renovations, no insulation or ventilation.

Figure 9 – Notice the temperature differential between a ventilated roof system versus an unventilated roof system.



of the various vented products required."

Pierce notes that the main benefit of proper roof ventilation is "cooler roof decks, [which] allow for dissipation of moisture that forms on the upper parts of the roof system due to condensation [while meeting] the requirements of the asphalt shingle manufacturers."

Monterose stated, "The cool roof with designed ventilation works. The early morning frost does not disappear until the sun comes up, [nor does] the snow melt [to] create ice dams at the eaves and valleys."

ST. JOHN'S LUTHERAN CHURCH

Last year, St. John's Lutheran Church in West Bend, WI, decided that its heating and air-conditioning expenses needed to be reduced. Parishioners realized an increase in spending because the roof had no ventilation system or insulation (see *Figure 8*).

Herrera Roofing was called on to aid the congregation. Adam Brissman, general manager of Herrera, noticed that the roof also "had some hot spots that were causing the shingles to prematurely deteriorate. This was because [there was] no real ventilation."

"It's very important that design professionals understand the relationship between certain roof variables, particularly air space, and how they impact the effectiveness of ventilation," says Marlea Knox, CDT, technical sales specialist for Metal-Era. "This isn't just an issue for cold climates with ice-damming concerns but also for warmer climates, because proper ventilation helps prevent premature shingle degradation."

According to Mike Coughlin, president of Cornell Corporation, "[Tests] have demonstrated a temperature drop of the roof sheathing of up to 20 degrees Fahrenheit on a hot summer day [when using a vented roof system]. This translates to lower shingle temperatures and allows the asphalt component to remain under its liquidus temperature." (See *Figure 9*.)

Coughlin observes, "The roof geometry and layout are of prime importance in

Figure 10 – A partial installation of the vented nail base on St. John's Lutheran Church.

determining proper roof ventilation. Hips and valleys can create hot spots that can degrade roof coverings quickly under extreme conditions."

To reduce energy loss through the roof, a ventilated nail base with 4.5 in of polyisocyanurate insulation and a 1.5-in air space were used (see *Figures 10* and *11*). To ensure the proper intake and exhaust airflow balance, the eave and ridge vent manufacturer assisted with the measurements and calculations.

"The ventilation helps prevent conflicting climates and temperatures so that the shingles aren't exposed to varying temperatures on the top versus bottom sides," says Brissman.

Upon completion, the congregation was very satisfied with the results and reports that its heating bills have been greatly reduced. Also, the congregants anticipate a longer shingle life.

PUTTING IT ALL TOGETHER

Ice dams, excessive energy bills, premature shingle degradation, and moisture buildup are frequently the result of ineffective roof ventilation. As illustrated through these brief examples, a proper ventilation strategy will maximize the life of the roof and reduce potential maintenance and cost issues in the future.

In order to create the proper airflow strategy for a commercial building, several elements must be addressed:

- **A balanced system:** Balancing the airflow intake and exhaust is one of the most important steps in establishing a roof-ventilation strategy, yet it is frequently the most overlooked. A properly balanced ventilation system requires that the intake air space is equal to the air space at the ridge.
- **Lower pitches:** Among the unique characteristics of commercial structures are lower pitches. Air moves more slowly through a lower-pitched roof system, increasing the need for a larger air gap in those systems.
- **Longer runs:** Designing a system with the correct air gap is particularly important in commercial buildings because they typically have longer runs. As the length of the run increases, the ventilation perfor-

Figure 11 – Installation of the eave ventilation system on St. John's Lutheran Church.

mance can decrease if the air gap is not large enough. A good rule of thumb is that runs over 20 ft will require air gaps larger than 1 in.

- **Product selection:** Remember that not all ventilation products offer adequate NFA for commercial projects, and the majority of products on the market are intended for residential applications. Because a 1-in air space is often insufficient to properly move air through a commercial roof system, products that can accommodate a larger air gap are often needed. Research has shown that in many instances, adding even one-half inch will make a significant improvement in the effectiveness of the ventilation system.

It is important to work with the nail base, eave, and ridge-vent manufacturers to select a product with the appropriate NFA for a particular project. Using tools such as online calculators can assist in determining a project's needed NFA.

Fortunately, as Roe observes, "There is more interest overall in adequate ventilation." With added industry awareness of commercial ventilation and increased education and understanding, ventilation-related problems should decrease over time, and there should be longer-lasting, more sustainable buildings.

Tony Mallinger

Tony Mallinger is the chief operating officer for Metal-Era, Inc. He spearheaded Metal-Era's committee for conducting research on how wind acts on a ventilated roof system. He is actively involved with the Single-Ply Roofing Industry (SPRI) and serves on SPRI's ES-1 task force. He can be reached via e-mail at tony@metalera.com.

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RCI Seeks New Director of Educational Services

Anticipating the retirement of Jerry Teitsma, RCI is seeking a new director of educational services. The individual will be responsible for identification, development, and administration of RCI educational programs and services designed to assist in the professional development of consultants. Specific job duties include but are not limited to:

- Administer RCI educational programs and services.
- Develop new and maintain existing classroom and Internet-accessible programs, products, and services that address the educational needs of the membership and the industry.
- Maintain a long-term schedule and a cadre of volunteer instructors for the classroom delivery of educational programs.
- Prepare and monitor the annual operating budget for the Educational Services Department.
- Prepare articles for *Interface, RCItems*, and other industry publications.
- Attend and provide assistance for various RCI events, including annual conventions and topic-specific symposia.
- Maintain updates on technical activities, consulting, and industry practices affecting RCI members, as well as government actions, model code and standards-setting organization actions, and insurance industry initiatives or positions taken by building materials manufacturers.
- Maintain liaison with important industry organizations, including national associations representing manufacturers, designers, consultants, and building owners, as well as code and standard-development organizations.
- Develop educational presentations that can be offered to various industry groups.

Qualifications: Must possess a BA, BS, or equivalent in education with strong teaching experience. A BS degree in architecture or engineering will also be considered if applicant has strong teaching experience. Three or more years' experience as an education provider is desired. Thorough knowledge of building codes and standards and construction industry practices is required. Familiarity with various computer software and systems, including those utilized in distance learning development and application, is required. Persuasive communication skills, ability to multitask, and the highest levels of integrity are expected. Association management experience is very helpful. Must have excellent organizational and people skills. Must be detail oriented and have excellent writing skills. Candidate must be willing to travel in the U.S. and Canada.

Application procedure: Send résumé to RCI, Inc. at 1500 Sunday Dr., Suite 204, Raleigh, NC 27607 or by e-mail to jbirdsong@rci-online.org. No telephone calls, please.