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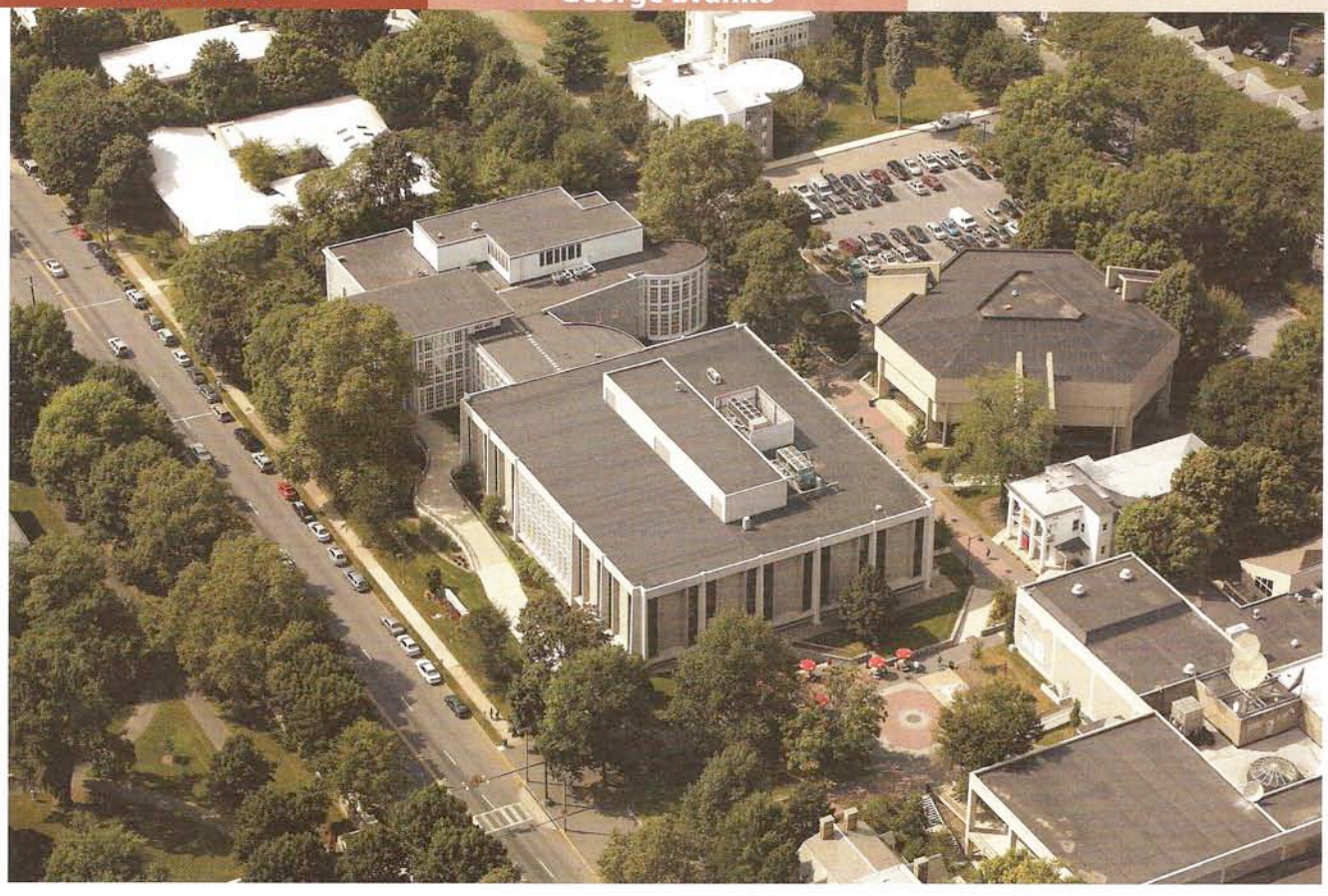

Photo courtesy of Carlisle SynTec

Not Just Black and White

There is no one-color-fits-all answer to selecting energy-efficient roofing.

One of the most important line items on a building owner's budget these days is the one covering heating and cooling costs. Oil prices are high and extremely unstable; natural gas and coal prices are also on the rise, forcing building owners to do all they can to keep costs in check through the use of energy-efficient building materials.

Perhaps nowhere has the focus on energy efficiency in buildings been greater than in the roofing industry. Numerous codes have been developed, organizations formed, and regulations established — all in the interest of addressing the issue of energy efficiency. Throughout the past decade, energy-efficient roofing has focused on cool roofing, which utilizes light-colored materials such as thermoplastic polyolefin (TPO) to reflect sunlight and solar energy away from a building and keep it cooler.

To encourage this focus, thermoplastic roofing manufacturers have touted the energy-efficient benefits of these reflective materials. The TPO marketing efforts mirrored the work of manufacturers of PVC membranes, who used its popularity in Europe as a basis to establish what was becoming a respectable share of the U.S. low-slope roofing market.

Numerous studies have indeed shown that, under some circumstances, a building's air conditioning-related energy consumption can be reduced through the use of reflective roofing. These studies, along with some overly enthusiastic marketing efforts, have helped create a perception within the roofing industry that reflectivity is the best option for reducing energy consumption.

Geography Plays a Role

But, that philosophy has a flaw, and caution must be used when specifying cool-roof systems. The energy savings that buildings experience due to the use of reflective roofing materials are most often realized in warm, southern climates where cooling degree days (CDD) outnumber heating degree days (HDD), and air conditioning is more prevalent than heating.

To help reduce heating-related energy demands, which are greater than air conditioning demands in northern regions, dark-colored materials, such as EPDM membranes, are most often beneficial. Dark materials like EPDM absorb heat and transfer exterior solar energy into a building, causing interior temperatures to rise, helping to alleviate the demands placed on heating systems.

This reality differs from the current misconception that reflective roofing is the panacea for all buildings' energy woes, regardless of geographical location. When viewed strictly from an energy-efficiency perspective, research and data prove that materials like EPDM can provide the same, or better, energy savings as a light-colored alternative in many locations.

Table 7.4 of the 2007 *Buildings Energy Data Book*, published by The Building Technologies Program within the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, outlines energy use intensity in various commercial building types, comparing heating and cooling as a percentage of total energy consumed. The average results show that heating accounts for 29 percent of the energy consumed within a building, while cooling totals a mere six percent. The statistics are even more compelling when broken into specific building segments, such as healthcare and educational facilities, which feature 55-to-10-percent and 33-to-five-percent heating-to-cooling ratios respectively.

These numbers indicate that the move toward reflective roofing in many parts of the country may be counterproductive to the goal of minimizing overall energy consumption. Instead, there should be more focus on cutting heating costs, not cooling costs.

The Cool Roof Calculator

The U.S. Department of Energy (DOE), in conjunction with its research wing the Oak Ridge National Laboratory (ORNL), has developed a Cool Roof Calculator to help consultants, architects, roofing contractors, and building owners determine the most efficient and cost-effective roof system for any given project. Accessible through the DOE Website, the Cool Roof Calculator simulates building energy consumption based on the type of roofing membrane and amount of insulation that is installed.

Users can pinpoint the analysis within the Cool Roof Calculator based on the zip code of their project, resulting in direct, head-to-head comparisons of various roofing assemblies. In most instances, dark-colored membranes will prove to be more energy efficient than light-colored materials for projects located in cooler climates.

The School Building Authority (SBA) of West Virginia recently used the Calculator to develop its Quality and Performance Standards, which outlines specific products and minimum performance qualifications for state-funded school construction and renovation projects. In the group's original draft, reflective roofing materials were identified as a mandatory specification for all statewide roofing projects.

The West Virginia SBA board believed this would help the state's school districts cut their annual energy costs. When the standards were sent out for review, many local roofing professionals began to question the use of reflective materials.

Ed Smith, manufacturer's representative with North Coast Commercial Roofing Systems in Huntington, WV, was one of the first to raise concerns over the potential use of reflective roofing materials in a state that features far more HDDs than CDDs.

"I've been in the roofing business in West Virginia for nearly 30 years," said Smith. "This state has a long and successful history with dark-colored membranes, especially EPDM. I know reflective roofing is gaining in popularity, but it simply does not produce the energy savings in West Virginia that many would expect."

So, Smith contacted a manufacturer of both white and black membranes, to help him show the SBA that they would actually lose money if they opted to mandate reflective roofing on state schools. The manufacturer turned to Randy Koller, a certified energy manager for 28 years, who simulated a number of scenarios at various locations throughout West Virginia using the DOE's Cool Roof Calculator. Koller compared 60-mil reinforced TPO and EPDM membranes to determine what effects both materials would have on energy costs and the resulting carbon emissions.

In every scenario Koller ran, the EPDM roof system proved to be at least 10 percent more energy-efficient per year than the TPO. Smith took those results back to the SBA board to show them what could happen if they mandated reflective roofing materials throughout the state.

Upon reviewing the data that was compiled, the board developed a new roofing specification that called for 60-mil EPDM and at least two layers of staggered polyiso insulation.

Insulation Plays a Vital Supporting Role

While Koller's findings prove that black membranes are more beneficial in cooler climates, what was truly interesting was the importance that insulation played on the overall energy demand for all of his simulations, regardless of membrane color. When he ran the analysis on R-32 roofs,

the energy savings attributable to membrane color were dramatically lower than those with an insulation value of R-15, and more importantly, the difference in energy costs of the white and black roofs began to shrink as the R-value increased.

"Research shows, that from an energy perspective, insulation often negates membrane color," said Andres Desjarlais, group leader for building envelope research at the Oak Ridge National Laboratory (ORNL) in Oak Ridge, TN, the research wing of the DOE. "Reflective roofing should not take the place of quality design, of which insulation is a key factor."

A superior option for any low-sloped roofing, white or black, is to utilize two layers of fully adhered insulation, minimizing the effect of thermal escapes at the joints of the insulation and through the fasteners, resulting in a more airtight and efficient assembly.

Another Option: Ballasted Systems

One other option to consider when developing energy-efficient roof systems is EPDM ballasted roof systems, the oldest and most time-tested single-ply roofing system available. Ballasted systems were extremely popular when EPDM first entered the roofing scene in the early 1960s because they provided a low-cost, easy installation, with insulation and membrane loose-laid onto the roof deck and secured in place with stones or pavers of various shapes, sizes, and weights.

In May of 2008, the Single-Ply Roofing Institute (SPRI) released a report on a joint study with the DOE and EPDM Roofing Association (ERA) entitled, "Evaluating the Energy Performance of Ballasted Roof Systems," that showed that ballasted systems can save as much energy as a reflective roof.

The cool-roof benefits of ballasts make them an ideal alternative to the growing number of reflective roof systems being installed in northern cities where HDD outnumber CDD by a more than five-to-one ratio. Many such cities are looking to reflective roofing to help counteract the formation of urban heat islands, which can cause city temperatures to be as much as five or six degrees higher than the actual temperature.

Always Consider All the Options

It is highly unlikely that a consensus will ever be reached within the roofing industry as to what constitutes the best system in any given location. Luckily, the emergence of energy and lifecycle analysis programs such as the DOE's Cool Roof Calculator will help validate or refute claims being thrown around by all sides.

One thing is for certain: EPDM has proven to be a long-lasting and dependable roofing option for the past 45 years, with a proven record of achievement in energy efficiency, which should be taken into consideration when making decisions on an energy-efficient roof system. Reflective roofing materials definitely have a place within the industry, but so too does EPDM.

"No roof system should be shoved down people's throats," said Desjarlais. "I'd like to see the availability of all options, and let people choose based on what is the most economical and efficient for their needs." CPM

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