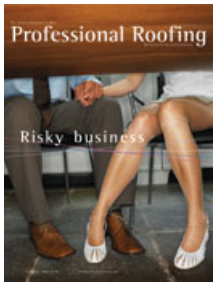

Speaking from experience

A roofing professional shares his views about the roofing industry

by Thomas W. Hutchinson, AIA, RRC

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Editor's note: The following views are those of the author and not necessarily those of NRCA or Professional Roofing *magazine.*

During the past 20 years as a roof consultant, architect and former president of RCI Inc.—The Institute of Roofing, Waterproofing and Building Envelope Professionals (RCI), I have met many roofing professionals who have shared a wealth of information. Additionally, I spent hundreds of hours in the field and through empirical experience have learned many interesting things about the roofing industry with regard to building codes, products, energy and environmental issues, and business issues, among other things.

Following are my observations regarding roofing industry issues and concerns.

Code effects

In April, a discussion began at RCI's convention in Phoenix. FM Global had made substantial changes to its wind-uplift standard in January and did not provide notice to or consider the effect on the roofing industry.


Photos courtesy of Hutchinson Design Group Ltd., Barrington, Ill.

Roofing Industry Committee on Weather Issues (RICOWI) Inc. wind event reports repeatedly tell us roof system failures begin at a roof's edge. Yet FM Global has made rather significant changes to Property Loss Prevention Data Sheet 1-29, "Roof Deck Securement and Above-Deck Roof Components," without addressing a root cause of loss. The changes particularly affect the design of fully adhered roof systems that require a Class 1-90 rating or higher on steel decks.

Fully adhered roof systems are defined by FM Global as "those systems that are hot-applied built-up and modified bitumen membranes, torch-applied modified bitumen membranes, cold-process built-up and modified bitumen membranes, self-adhering modified bitumen membranes and single-ply membranes, and fully adhered single-ply membranes installed over mechanically attached insulation, with or without a cover board on a steel deck."

Before the changes, the requirement for perimeter and corner attachment was met simply by increasing the number of fasteners in perimeter and corner areas for the listed systems. The newly revised data sheet issued in January without notice (FM Global has indicated it is incumbent upon design professionals and roofing contractors to periodically review FM Global standards) now states a prescriptive method for increasing the fasteners in the corners cannot be used for fully adhered roof systems requiring a Class 1-90 rating or higher. Instead, these roof systems must meet a higher tested rating for perimeter and corner areas.

No engineering rationale for these changes was given, and few fully adhered roof systems can comply with the requirement. The result is these changes effectively eliminate the use of fully adhered roof systems in a Class 1-90 or higher classification on steel decks because the roof systems must comply with Loss Prevention Data Sheet 1-29.

Additionally, the newly revised data sheet requires the minimum number of fasteners in perimeter and corner areas for Class 1-60 and Class 1-75 listed systems to increase 50 percent and 100 percent, respectively. Loss Prevention Data Sheet 1-29 still allows for a prescriptive enhancement of perimeter and corner areas for mechanically attached systems, including mechanically attached base sheets and multiple-ply asphaltic systems. For these systems, the number of fasteners in perimeter and corner areas prescriptively can be increased as allowed previously.

As I mentioned, these changes were made without notice to the roofing industry. As a result, the Asphalt Roofing Manufacturers Association (ARMA), Chemical Fabrics and Film Association, EPDM Roofing Association, Federal Emergency Management Agency, NRCA, RCI and SPRI have formed a coalition and are considering ways to address the implications of these changes.

Although I never have designed a roof system that needed to comply with FM Global insurance standards, I have designed roof

Although I never have designed a roof system that needed to comply with FM Global insurance standards, I have designed roof systems that comply with FM Global's 1-29 data sheet. It must be said roofing and design professionals have used FM Global data sheets as a fallback for quality assurance. It is time the responsibility for roof system design is placed squarely with design professionals. The coalition forum currently is working on a wind-design standard that will go through the American National Standards Institute's canvassing process.

It appears changes to FM 1-29 were perpetuated by losses in FM Global-insured buildings. Many of these losses reportedly occurred in Puerto Rico where high winds were sustained and damage was extensive. I dislike many of the codes' provisions that allow almost every compliance possibility to be achieved through various exclusions. If metal decks are failing in Puerto Rico, I'd rather see FM Global and code bodies eliminate metal deck use and require concrete decks to achieve appropriate wind-uplift performances. Personally, I like the Midwest Roofing Contractors Association's response; the organization will not comply with the new data sheet.

Title 24

Energy conservation techniques in California during the past decade have resulted in substantial energy savings, as well as moving the peak energy demand to later in the day when the demanded capacity of the energy producers can be met. However, it is interesting that much of the roofing information being directed toward the California Energy Commission (CEC) comes from Lawrence Berkeley National Laboratories (LBNL), Berkeley, Calif.

During personal discussions with LBNL researchers about their studies of insulation thermal performances, I questioned why their results for various cover boards differed. The response was shocking because they indicated they did not know what a cover board is. Yet they hope to produce documentation regarding insulation's thermal value with little knowledge of how cover boards may affect codes. These disturbing occurrences are happening more frequently in the roofing industry.

During a recent CEC hearing, the full cost implications of increasing the mandated reflectivity and emissivity of materials was presented to the board. Gladding, McBean & Co., a 100-year-old manufacturer of quality terra-cotta products based in Lincoln, Calif., clearly indicated if CEC energy-efficiency standards were raised, Gladding, McBean would go out of business. This is a company that has done a lot of historical terra-cotta work. CEC needs to realize there will be a cost for raising the standards, in this case resulting in the loss of historical restoration opportunities.

Additionally, ARMA research indicates a cool roof system installation could cost as much as $1.80 per square foot more than traditional systems. What is the cost benefit of a cool roof, especially when the cost of maintaining and cleaning such a roof has not been incorporated? Although initiatives such as Title 24 have done a lot to implement product innovation, there is a limit to what the cost effectiveness of those innovations can be.

ENERGY STAR®

The Department of Energy's and Environmental Protection Agency's (EPA's) ENERGY STAR program is unique. We all know we can go into an appliance store and purchase ENERGY STAR-rated appliances built with parts that are exactly alike. How EPA makes the large jump to roof system installation, where almost every roof system is different and installed with different application conditions in different climatic conditions, and then is able to address only a single component (roof surfacing) of roof systems is beyond my understanding.

However, recent discussions with EPA have revealed its main concern is with urban heat islands. Although the idea of reducing urban heat islands is honorable, it's shortsighted when only roofing is considered. Massive amounts of asphalt and concrete continue to denude the earth of its vegetative areas. Inner-city buildings with solid masonry walls are not considered. Increasingly, more local governments are adopting ENERGY STAR standards for roofing into their codes with little understanding of the implications.

Discoveries

In 2001, Chicago adopted a new energy conservation code that mandated high reflectance and emissivity values with regard to roofing. The initial recommended reflectance value subsequently has been reduced because of the roofing industry's efforts.

Science now is validating what many have known all along—that ballasted roof systems can be some of the coolest roof systems.

Other energy-related discoveries have been made, as well. For example, recent research by Oak Ridge National Laboratory, Oak Ridge, Tenn., has concluded some ballasted configurations provide the same benefit as more recognized cool roofing options, such as single-ply membranes. Applications of ballast at rates of 15 pounds or greater and/or paver systems provide the same surface temperatures as cool roofing options. They also have the added benefit of moving the heat load into a building to a period later in the day. Proposals to CEC were well-received.

Although this recent research has positive results for the roofing industry, International Code Council code hearings during September 2005 resulted in a code change, limiting ballast use in coastal areas. There appears to be confusion in the code industry with regard to ASTM D448 No. 4 stone or larger and the small "pea gravel" used in built-up roof systems.

Energy conservation

I believe in the installation of high thermal value roof system applications. Typically, for occupied buildings, R-30 or greater is what I recommend. Multiple layers of high

for occupied buildings, R-30 or greater is what I recommend. Multiple layers of high thermal insulation will provide constant protection for buildings.

For example, I recently worked on a project in Milwaukee, where people are attuned to energy costs. The client was paying 6 cents per kilowatt-hour (kwh) and anticipated in the fall the cost would reach 13 cents per kwh. In fact, it reached 15 cents per kwh. Imagine the effect on anyone's budget when a cost doubles. Had the client not been attuned to energy conservation and replaced roofs with only one layer of insulation, which is typical in many locations, the client would have been paying for the error during the next 20 years.

Another project was at a school in which the fieldhouse is heated and cooled during the year to maintain a 72 F temperature. The design incorporated a vapor/air retarder and then was super-insulated with R-30 insulation at the drains and tapering up to a high point of 17 inches of insulation. Reports from the school district indicate cost savings during the past four years almost have offset the entire cost of insulation for the project.

In 2005, Congress enacted an energy tax credit for the use of additional insulation 50 percent above and beyond what ASHRAE 90.1 requires. The Internal Revenue Service still is working out the details regarding how the tax credit will work. However, this tax credit not only can be forwarded to the owner, but if it is for a public facility where there is no tax implication, it can be forwarded to the designer.

It is my firm belief that when the U.S. actually takes energy conservation seriously, design standards such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers' standard should be doubled and a mandated minimum prescribed for buildings. Although this is an overly simplistic approach because buildings vary, I cannot overemphasize the idea of low-cost thermal insulation installation versus high energy costs. I see it not only as an energy cost concern but limitation of potential energy sources.

Cost of doing business

The tremendous rise in the price of a barrel of crude oil has resulted in a rise in gas prices. Additionally, the cost of asphalt during the past nine months for roofing applications has risen substantially as has the cost of shipping. This all can affect contractors' overhead costs, decrease profits and result in discussions with general contractors that can lead to overall concern for the roofing industry.

Some contractors have purchased products, such as mopping asphalt, bituminous products and insulations, and stored them in warehouses until they can be used—sometimes three months or four months in advance. This situation requires handling products twice, proper material storage and the possibility of not being paid for shipped materials. These cost increases, most of which are unanticipated and often increase during a project, have resulted in situations where cost has escalated beyond anticipation and requests for compensation often meet with refusal.

An example of a typical pipe penetration curb on a project in Chicago where the drive to be cheaper is resulting in unorthodox practices and numerous premature roof failures.

The design profession needs to discover a way to properly address these cost increases during bidding and performance of a project so owners do not pay excessively for cost increases. Contractors are not required to assume costs that may result in a decrease of quality installation because of the financial pressures of having to pay more for a product days in advance. This is controversial for larger projects with long construction time periods. Many projects in downtown Chicago are 18 months to 24 months out; trying to estimate the cost of materials with an 18-month to 24-month lead is difficult.

Additionally, the cost of insurance continues to rise. In some areas of the U.S., a contractor's insurance cost is incredibly high. The cost per person per hour would be a good wage by itself.

Certainly, these types of challenges are being handled as best as can be expected by many contractors, but as a designer, I also am concerned the continued unabated cost increases for materials will affect the quality of finished product my clients receive.

Flashback

In 2004, there was what appeared to be a shortage of polyisocyanurate because of a number of factors—most notably, the reduced availability of MDI (methylene diphenyl diisocyanate). This resulted in panic buying. Contractors and distributors were buying large amounts of polyisocyanurate every month and storing it because the next month it was priced even higher. The result was large amounts of perhaps improperly stored material, which may have long-term, far-reaching consequences.

Incorporating high thermal value into a roof system is one of the best ways to

Whether the material was placed long-term on a job site or in a warehouse, some of these materials just now could be delivered to project sites. It has been noted that when cutting open the protective covering on many of these long-term storage polyisocyanurate bundles, mold has been found on the insulation facers. I have not observed a lot of in-field roofing industry personnel moving these boards away from the roof before installation, and I suspect they are being installed. Owners and design professionals must be sure they are receiving new material on their job sites that has been packed properly, stored and delivered in good condition.

Green roofing

roof system is one of the best ways to assure a building owner of continued energy cost savings.

The roofing industry offers various educational opportunities with regard to green roofing, but most, if not all, are dominated by discussion of rooftop vegetation. Obviously, this is an important part of a roof system when it is considered a green roof system. But has the industry forgotten a roof's purpose is to protect a building's interior from moisture intrusion?

There are many people with gardening knowledge who do not completely understand the effects of products they are putting on roof systems. Manufacturers have banded together with a number of proprietary garden systems to educate clients and bring a full package to design and contracting communities. This is a step in the right direction.

Green roof systems began in Europe because antiquated drainage systems in France, England and Germany could not handle the volume of water being distributed by the growth in building construction after World War II. Consequently, mandates for rooftop gardens were initiated to mitigate water runoff. These mandated roofs were of substantial thickness and contained soil medium that retained water.

When garden roof systems arrived in the U.S., the roofing industry tried to improve the design, which has resulted in green roof systems that are shallow in depth, provide little water retention and are aesthetic coverings of roof systems. Additionally, green roofs have no fire rating. The tremendous cost of installing green roof systems still is problematic for almost all but the wealthiest clients.

Future issues for green roof manufacturers to address are product warranties, required maintenance, removal of overburden to repair leaks and applicator approval.

TPO

TPO roof membrane installation in the U.S. has reached an age of about 12 years. After several initial failures and publication of an ASTM International standard, it seems many manufacturers' formulations have reached equilibrium and now are fairly stable.

Field observations have shown a few characteristics unique to the product. For instance, most users new to TPO will find the membrane quite stiff, especially in colder temperatures. This makes membrane installation challenging when one wants to roll it back to weld and/or fully adhere the membrane. It has a much higher roll height when folded than other single-ply membranes. Contractors who wish to weigh down the membrane with weight on the folds have found fold creases imprinted on the membrane that do not relax or come out. Only future observation will reveal whether cracking appears in those areas.

Also, observation of in-place TPO roof systems of more than three years to four years of age reveals a certain amount of membrane tightness. This is indicative of potential shrinking though pulling at roof edge perimeters and/or fastener locations was not observed to be significant at this time. In addition, installation of TPO roof systems directly over in-place roof systems and without significant slope results in ponding water and a certain amount of chalk buildup in the ponding areas.

The Western States Roofing Contractors Association (WSRCA), National Research Council of Canada and TPO membrane manufacturers have been testing in-place TPO roof systems. One significant observation is membranes seem to be thinning to a slight degree indicated by a slight decrease in the weathering surface thickness over scrim over time though reduction in performance or watertightness was not noted. An update of the report can be found on WSRCA's Web site, www.wsrca.com. As with all new roofing products, time is the great test; their prognosis for longer term performance while looking good still is unknown.

With regard to the reroofing market, it appears a number of multi-ply bituminous roof systems over 1-inch-thick perlite or fiberboard are being removed and replaced with mechanically fastened TPO roof systems. Although the original roof systems may have performed adequately for the most part during 20 years, the new roof systems, composed of a 1 1/2-inch-thick layer of polyisocyanurate roof insulation overlaid with a mechanically fastened TPO roof system, are being installed.

The reason for the selection of the replacement roof system appears to be two-fold: the cost effectiveness of installing a mechanically fastened system and reported research publicizing the fact that a white membrane in association with reduced amounts of insulation provides the same benefit as greater insulation amounts with darker roof membranes. But this concept does not consider the dynamics of roof systems as they act in relation to buildings.

The result of one layer of mechanically fastened insulation with a mechanically fastened TPO membrane has resulted in moisture-containing air moving through insulation joints to the underside of the TPO membrane, which causes condensation at various times of the year. Therefore, insulation is getting saturated. Perhaps incorporation of a vapor retarder would help. Now the quandary is such that a roofing manufacturer who guarantees the watertightness of a roof issues a warranty on a roof that is watertight but has insulation that is completely saturated. The designer appears to have based his design on information provided by someone with little liability or investment in the industry, which resulted in these roof system conditions. How this plays out in the long term is yet to be discovered.

It is my supposition that as more recommendations by those who have no vested interest in the roofing industry result in field concerns, sooner or later attorneys will seek restoration or correction of problems that resulted from these shortsighted recommendations.

EPDM roof systems

Previous and recent research has found EPDM membranes—because of their carbon black composition—have tremendous ultraviolet resistances. Introduction of new accessory products, such as seam tapes, as well as the culling out of unqualified

contractors, have resulted in increases of quality installations.

Aged EPDM roof systems that were designed well in the first place and have exceeded their warranty lengths are being restored to extend their service lives up to 10 years to 15 years at minimal cost. It still is to be determined whether such membranes can be restored yet again. Issues with regard to potential shrinkage often are related to improper installation and/or design detailing at the roof edge perimeters as earlier sheets had allowable shrinkage of 2 percent. This was not accounted for in the installation and/or design detailing.

Research by John C. Beech, a researcher from Garston, Watford, United Kingdom, investigated the performances of black EPDM membranes from the Middle East where the climatic conditions result in daily temperatures well above 120 F. He found that in-field material—when tested under cyclic fatigue—did not fail after 500,000 cycles. Intuitively, it could be suggested that because of its resistance to ultraviolet light and high-level performance in tremendous heat and sun locations, the material to use for long-term performance in harsh, hot and sunny climatic conditions is a carbon black, impregnated EPDM roof membrane. Although when low amounts of thermal insulation are used, added heat load can be an issue for a building owner.

Self-adhering membranes

The idea of using a self-adhering membrane to reduce applicator error and improve installation productivity and ease of application is excellent but presents challenges. It was tried years ago by W.R. Grace & Co., Cambridge, Mass., with its G.R. Membrane Systems. I spent 10 years patching seam delaminations and replacing those Grace roofs. As I was told years ago by those experienced in the roofing industry, "What goes around generally comes around."

I have observed a great many steep-slope conditions where the self-adhering ice-dam protection membrane barely sticks to the plywood because of the lack of tack or presence of surface contamination on substrate materials. Now, the industry is looking at a low-slope self-adhering membrane being adhered to a substrate, which generally is not a clean surface.

I've had experience with a number of self-adhering membranes and found once they are installed properly, they perform well. Applicators and designers quickly learned that laps need particular attention and need to be heat-welded for bituminous self-adhering membranes. Adhesion is better after a base sheet and/or deck application is blown dry and all surface contaminants removed. Climatic conditions also affect bond integrity. A sunny day of 40 F is much different than 50 F on a dark, cloudy day. Additionally, wind and humidity are concerns. In the fall in many northern climates, roofs are covered in a heavy layer of dew and/or frost, which sometimes takes hours to dry.

I have no experience with the self-adhering single-ply membranes that have been introduced to the market recently, but though I like the environmental aspect of the products, I would have many of the same reservations and concerns for their applications.

They appear to perform well for limited and specific project types, but I don't see a large market share for these types of membranes in northern climates.

Accessory products

The introduction of polyurethane foam adhesives into the roofing industry provided a unique application opportunity for designers and contractors. My experiences with polyurethane foam adhesives have been positive, as well as downright scary.

As with any adhesive technology, the bond between two surfaces is the result of proper preparation of the substrate surfaces to receive the polyurethane foam adhesives. There are two application methods: bead application and spray foam application.

My reservations with bead foam application stem from inherent deck deflections and a general lack of some manufacturers to take responsibility for their product failures. On numerous occasions, especially on concrete roof decks, I have observed bead foam adhesive application where the deck deflection was such that the top of the beaded application did not even touch the underside of the insulation facer. This was observed when the roof edge blew off. Not only did the bead application inadequately contact the underside surface, its adhesive bond to the concrete was poor. It could be removed by simple hand uplifting pressure.

I encourage contractors who use bead foam adhesive to be sure they obtain positive contact and suggest the insulation bond require repeated pressure by foot traffic or waiting to achieve positive bonding.

A suggestion for roof insulation manufacturers is to install lines on the insulation facer at 6-, 8- and 12-inch locations to achieve a more consistent on-center application. A roofing crew member eyeing a 12-inch on-center spacing is much different at 6 a.m. than at 2 p.m. when it is 95 F.

Personally, I prefer the application of a full-coverage spray polyurethane foam adhesive application method for achieving positive adhesion of all layers of the specified roof system. But there also are concerns with this application.

The tenacity of this adhesive as it rises is exceptional, much greater than with bead foam adhesive. As the material comes out, covering the substrate, it expands in both directions, engaging the membrane and/or substrate surfaces in a method low-rise foam cannot achieve.

However, this method easily affects other building components, especially clerestories; sheet metal; and heating, ventilating and air-conditioning equipment, because spray application and proper protection are required.

In addition, a knowledgeable on-site mechanic is necessary because breakdowns of pumping machines and spray nozzles are common and worker safety is paramount. I caution all applicators to follow the product data and technical information data sheets during use, including the use of respirators. This includes roof consultants, architects and any observers. Continued

exposure to spray foam has been known to result in extreme sensitivity to the product. The same material that is airborne and contacts other building components and/or vehicles also enters lung tissue.

One discouraging aspect of spray foam adhesive that I experienced this year was the intense odor of the material when used on a metal deck. During the project, the material was specified in the hope of minimizing any disturbance to interior occupants of the building as opposed to mechanical fastening of insulation. The intense odor on the interior had the opposite result—entire floors of the building were evacuated because of solvent fume infiltration throughout the building. Caution should be exhibited in this regard. The fume issue is similar to what is being experienced with cold-process materials that have high solvent contents.

Designer knowledge

Sometimes, I am concerned about a roof system designer's knowledge, especially an architect's. This past year, I observed a large increase in specification of TPO membranes by many architects who have little understanding of how the membrane (or a roof in general) works, its installation methods and/or its detailing, which results in roof systems that will be less than productive. This may tarnish a membrane's reputation solely from its poor design standard.

When reviewing specifications as an expert witness, I am seeing greater reliance on the use of manufacturers' standard details or referencing of those details, which are the minimum standard. The architectural design community needs to understand that though manufacturers' details help, they also are market-driven and a bare minimum standard is not applicable to all projects. Architects need to design roofs. It takes only one trip to court to realize the law is clear: Licensed professionals design products; contractors install products; and manufacturers provide products.

My concern with the architecture industry is many architects completely misunderstand roofing in general. Reliance on poor or shadowy details is increasing, as well as writing specifications that are so basic and/or convoluted a contractor is free to choose from a multitude of often unequal options. It's obvious the direction that will take. A recent review of a metal specification—if you can call it a specification—revealed the architect only was interested in the color of the material rather than whether the system was installed using the manufacturer's recommendations.

Safety

Job-site safety should be a concern for all of us, not just those inherently at risk. Designers and construction observers also need to be concerned with job-site safety. The law is clear provisions for safety are contractors' responsibilities. I certainly believe in the altruistic idea that roof system designers also can design safety measures. Perhaps it should be mandated that davits along a roof edge be installed and used for life-safety systems and/or perimeter roof edge protection by both roofing and other tradespersons working on the roof. Raising the height of roof parapets to provide protection also is an area with room for improvement. Although many architects suggest the aesthetic aspect of a building would be affected by a high parapet, it did not seem to affect Louis Sullivan in his design of architectural icons of the early 1900s.

As RCI president, I worked with NRCA's Immediate Past President Reid Ribble, president of The Ribble Group, Kaukauna, Wis., to formulate an RCI/NRCA safety task force. The goal of the task force is to come to some conclusion with regard to the suggestion of appropriate designed-in safety measures that could be promoted by the design profession and roofing industry to influence insurance and code officials to adopt these standards.

The future

Roofing industry concerns have changed during the past decade. They are different in nature, and we all must direct our energies toward those concerns. Effective conversation with governmental co-bodies and understanding how the lobbying process informs the U.S. of appropriate data are future concerns. Hiring of appropriate lobbyists is going to be needed.

Additionally, it is encouraging to see how all aspects of the roofing industry have coalesced to discuss FM 1-29 concerns, Title 24 and other related issues.

This cohesive coalition of interested parties will affect the greater good of the roofing industry and effect more change. As always, it's the unknown that will keep us intrigued.

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