ISSUES PAPER ON LOW-SLOPED ROOFING

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New challenges and problem areas arise with changes in manufacturing processes, the introduction of new roofing materials and systems, and the seemingly innocuous changes in raw materials. This paper discusses the type of problems which have become apparent since the Third International Symposium on Roofing Technology in 1991 and some of the reasons for problem development. It is intended to be a relatively simple overview of the industry's most common problem areas, not an in-depth discussion of why the problems occurred. Included are brief discussions involving perlite roof insulation, EPDM seaming technology, Factory Mutual Research Corporation, polymer modified asphalt membranes and membrane coatings, glass fiber felts used with coal-tar pitch, phenolic foam insulation and steel deck corrosion, alternate blowing agents for isocyanurate foam roof insulations, facer delamination on isocyanurate foam roof insulations, and wind damage to roofing assemblies.

KEYWORDS

Alternate CFCs, EPDM seams, facer delamination, Factory Mutual Research Corporation (FMRC)/wind damage, PVC roofing membranes, perlite roof insulation, phenolic foam roof insulation, polymer modified asphalt roof membranes.

INTRODUCTION

Since the time of the Third International Symposium on Roofing Technology, a number of issues have arisen in the roofing industry which have impacted the industry in various ways and to greater or lesser magnitude. A number of upstart "suppliers" of roofing materials have entered the industry, floundered and failed leaving behind a substantial inventory of less than satisfactorily performing roofing assemblies. And the number of owners who suddenly realize the true value of roof system guarantees issued by companies without means to honor the guarantees has increased proportionately.

The past few years have seen the Factory Mutual Research Corporation (FMRC) become more involved than ever in the roofing industry, publishing far-reaching changes to previously issued Approval Guides and Loss Prevention Data Sheets, and the introduction of such guidelines as are included in FMRC Approval Standard No. 4470 wherein the Factory Mutual System has officially entered the business of full-system testing of roofing assemblies of all types. FMRC has enlarged their wind uplift test apparatus to better evaluate mechanically attached sheet membrane roofing assemblies and is in the process of acquiring and installing dynamic wind test apparatus to allow better understanding of risks associated with these types of roofing assemblies subjected to dynamic, real-world environments.

The "shattering" of early non-reinforced PVC roofing membranes has been a hot topic since the National Roofing Contractors Association (NRCA) called attention to the magnitude of the problem in a joint document issued by the Single Ply Roofing Institute (SPRI) and NRCA in 1990. *Project Pinpoint,* the NRCA roofing database, began to show a steep rise in the incidence of "shattering" of non-reinforced PVC roofing membranes which triggered a survey of NRCA members to attempt to assess the severity and magnitude of the "shattering" problem. When it became obvious that the problem was severe and extended throughout the United States with no indication of localized geographic or isolated problem areas, NRCA and SPRI issued a joint document which included recommendations as to how replacement and/or repair of non-reinforced PVC roofing membranes should be handled by roofing contractors.

There has been much past and present discussion about field seam formation in EPDM roofing membranes. Much study and effort has been expended in testing and evaluating adhesives used to form field seams. Most manufacturers and suppliers of EPDM roofing membrane systems have changed seam adhesive types (neoprene to butyl) which has, thus far, resulted in much improved field performance of adhered laps in EPDM roofing membranes. Others who have remained using neoprene-based adhesives require special seam preparation and application of "primers" in conjunction with the neoprene adhesives. With the current federal agency climate and the local VOC regulations, manufacturers and suppliers of EPDM membrane roofing systems will most likely convert from solvent-based adhesives to butyl-(or other polymer) based tapes for formation of field seams in thermoset membrane assemblies. Tape bonded field seams have been tried and forsaken by the industry on at least two separate prior occasions. New tape technology may prove adequate for long-term formation of field seams in EPDM roofing membranes, however a massive retraining effort will be required to get the contractor's field personnel up to full steam on tape application techniques to minimize the adverse performance exposure of unqualified installers. Tape seaming outwardly appears relatively simple, but prior experience dictates some caution in reintroducing tape seaming techniques without adequate field training support.

The original concept of polymer modified asphalt roofing membranes included SBS modified asphalt roofing membranes which were always marketed with some type of protective surfacing, and APP modified asphalt roofing membranes which were marketed with no inherent surfacing with claims that APP modified asphalt did not need additional surface protection. Time and Mother Nature have once again proven that bituminous waterproofing

membranes typically perform much better for longer periods of time when surface temperatures are minimized by the application of reflectant coatings. The confidence level of manufacturers/suppliers of unsurfaced APP modified asphalt roofing membranes began to be reflected in warranty terms: 10 years without coating, 12 years with application of reflectant coatings. Once the issue had been reconciled, the question of "which coating" to use became extremely relevant since some coatings offered to the market simply will not bond to the surface (weathered or not) of APP modified asphalt membranes. In general, solvent-based reflectant coatings have been more successful than water-based acrylic coatings at providing relatively long-term reflectance for the APP modified asphalt roofing membranes, but (because of VOC regulations) solvent-based coatings suffer similar problems as solvent-based adhesives, and the handwriting is on the wall. The roofing industry will probably, at some point, be forced to use non-solvent coating materials on unsurfaced polymer modified asphalt membranes and their development may be a challenge for both the coating suppliers and the manufacturers of polymer modified asphalt roofing membranes. The obvious alternative is factory applied ceramic or slate granule surfacing materials on APP modified asphalt roofing membranes similar to those applied to SBS modified asphalt roofing membranes in the manufacturing process. Some modifications to manufacturing processes will no doubt be in order.

Recognizing that factory fabricated polymer modified asphalt roofing membranes are not necessarily polymer modified asphalt roofing membranes, that physical properties of available polymer modified asphalts vary dramatically, that reinforcement type and placement of the reinforcement in the finished polymer modified asphalt roofing membrane will have varying effects on the application and long-term in-place performance of polymer modified asphalt roofing membranes, and that there are virtually no accepted performance criteria or standards for polymer modified asphalt roofing membranes in the U.S., the NRCA and Midwest Roofing Contractors Association (MRCA) set out to study the field performance characteristics of in-place polymer modified asphalt roofing membranes to determine which configurations of the polymer modified asphalt roofing membranes were performing as intended and the nature of problems associated with those not performing as intended. Results of that research should be available late in 1993. The National Institute of Standards and Technology (NIST) has set out on a similar tack and is in the process of collecting performance information on polymer modified asphalt roofing membrane assemblies, the results of which are to be reported in another paper in this proceedings. The main thrust of the NRCA/MRCA field study is to investigate field performance of APP and SBS modified asphalt roofing membranes, and to develop recommendations for maintenance and repair of the various types of polymer modified asphalt roofing membranes in the current roof system inventory. It is already obvious that the type and configuration of the polymer modified asphalt roofing membranes and the methods of installation have a significant impact on the potential long-term performance of the finished polymer modified asphalt roofing membrane assembly.

There has been some controversy associated with the use of glass fiber reinforcing material and Type III coal-tar pitch. There have also been some reported problems associated with the use of glass fiber reinforcements and "Old Style" Type I coal-tar pitch. In general, however, the glass fiber reinforced coal-tar pitch (Type I and/or Type III) roofing membranes appear to be functioning as intended, and most problems appear to be related to something other than the combinations of materials used in the glass fiber reinforced coal-tar pitch built-up roofing membranes. Coal-tar built-up roofing membranes are still offered by U.S. suppliers to the roofing industry and there is still some localized strong demand for coal-tar pitch built-up roofing membranes reinforced with either glass fiber or organic felt. Concern has been raised, rightfully or wrongfully, about compatibility reactions when using coal-tar pitch as the waterproofing medium in built-up roofing membranes reinforced with asphalt coated glass fiber roofing mats. There are other concerns about the porosity of glass fiber mats used with coal-tar pitch roofing membranes. Some pitch coated glass fiber reinforcing mats are available and there are many squares of asphalt coated glass fiber reinforced coal-tar pitch built-up roofing membranes in the current roof inventory which are apparently performing satisfactorily.

The subject of steel roof deck corrosion raised its head since the last symposium mainly in connection with U.S.-produced phenolic foam roof insulation boards applied directly over both painted and/or galvanized steel roof decks. The "corrosion" issue appears to be moot on all other types of roof decks. The problem was initially characterized as being most severe when phenolic foam roof insulation was installed beneath ballasted sheet membrane roofing assemblies, but it quickly became obvious that the problem existed to a greater or lesser degree in all types of roofing assemblies in which phenolic foam roof insulation was used over steel roof decks and when the insulation material became wet or accumulated moisture. Changes in phenolic production processes and/or attempts to modify the U.S.-produced phenolic foam roof insulation board failed to resolve the issue. Modifications to make the product commercially acceptable and cost competitive were expensive, so the product became economically undesirable and no longer competitive in the U.S. market; U.S.-produced phenolic foam roof insulation was withdrawn from the market in 1992. Phenolic foam roof insulation manufactured in Canada has remained economically viable. One of the Canadian-produced phenolics reportedly possesses different characteristics than the U.S.-produced product, and some Canadian-produced phenolic foam insulation has found its way to some northern U.S. roofing markets. Some formulations of U.S.-produced phenolic foam insulation exhibit aggressive corrosive properties in the presence of moisture—either in vapor form or free water. The original recommendation by NRCA was to utilize galvanized steel roof decks in lieu of painted steel roof decks, but it appears as though steel roof decks (painted or galvanized) are in jeopardy when in intimate contact with some types of phenolic foam roof insulation. It may take only a short time longer for the acid leachate to destroy the zinc protection on galvanized steel roof decks than painted (primed) roof decks. The one issue which

was finally brought into the open in the controversy was the fact that painted steel roof decks are typically provided by steel deck manufacturers with a "primer" coat only (which provides little or no corrosion protection to the steel roof deck panels depending on how badly the "primer" coat was damaged in handling and installation), and steel roof deck manufacturers recommend a final coat of protective paint be applied before installation of the roofing assembly, a step that never happens in the real world of construction and will not happen until specifiers become aware of the existing and long-standing positions of steel deck manufacturers. The other fact is that the primer finish applied by the steel deck manufacturers has served well for years and years, and replacement of corrosion damaged steel roof deck panels in localized areas is neither relatively difficult or particularly expensive.

The full extent of damage to structures incorporating steel roof decks caused by the U.S.-produced phenolic foam roof insulation remains unclear and may never be absolutely determined, since in the absence of moisture, deck corrosion appears manageable. Both major suppliers of phenolic foam roof insulation have launched major campaigns to attempt to evaluate their potential liability or to document the satisfactory performance of their phenolic foam insulation products over steel roof decks.

The use of alternate blowing agents for polyurethane-based (isocyanurate) rigid roof insulation boards has been under intense study by the industry and by Oak Ridge National Laboratory (ORNL) over the past three years. It appears that there are viable alternatives to CFC blowing agents which actually improve the physical/mechanical properties of the finished product. How much additional cost will be involved in the changeover is not yet clear, but at least there appear to be options for the suppliers of polyurethane-based (isocyanurate) roof insulations. Improved mechanical properties will be welcome, although it is doubtful that they will improve sufficiently to eliminate structural (crushing) damage to the foam cell structure during installation of the roofing assembly and subsequent maintenance traffic. NRCA Bulletin No. 9 was revised in 1988 to recommend the use of a cover layer of rigid, non-cellular insulation (wood fiber, perlite, or glass fiber) to protect the cellular plastic foam insulations from mechanical damage and ultimate deterioration under concentrated roof construction and maintenance traffic loads.

Delamination of glass fiber mat facers on polyisocyanurate foam roof insulations has been moderately troublesome primarily when some glass fiber mat faced isocyanurate roof insulations are used in conjunction with "adhered" sheet roofing membranes. There are allegations that some adhesives may affect the integrity of some facer mats, that some of the glass fiber mats retain sufficient process moisture to inhibit an adhesive bond, and that the plastic foam does not completely envelop the facer fibers during the manufacturing process thus eliminating the shear plane in the glass fiber mat. Whichever element or combination of elements is causing the problem, NRCA has established a task force to evaluate the facer separation issue. No information is presently available on the work which is still formative and in its infancy stage.

Wind damage to roofing assemblies has been in the forefront following Hurricanes Hugo and Andrew. Property damage from high winds associated with the two storms has been extensive and has allowed evaluation of the performance of various types of roofing assemblies under actual high-wind conditions. The consensus from all observations of the aftermath is that inadequate or inappropriate roof perimeter treatment is most often the cause for roofing assembly displacement under wind loads. Roof perimeters and roof accessory metal installed in accordance with current Factory Mutual Research Corporation, NRCA and some Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) recommendations have generally performed better than perimeters constructed not in accordance with the recognized recommendations, but it is obvious that more attention to perimeter details and attachment of accessory metal is in order for all of the organizations. When metal sections extending over roof edges (including improperly secured gutters) are not installed with hook strips (cleats) or straps of adequate size; or when "saddle cleats" for metal coping or cleats for perimeter gravel stops/curbs are fabricated from too light gauge metal, roof perimeter metal has become displaced under wind loads and roofing assemblies have followed the metal off of the roof deck surface. NRCA has recommended changes to model Building Codes based on observations and conclusions of surveys conducted immediately following the storms. The model codes do not presently address perimeter attachment of roofing assemblies.

And if all this wasn't enough activity, an old and trusted insulation material came under fire by contractors recently as problems began to become apparent in some roof system installations including perlite roof insulation. The industry hasn't yet agreed on the differentiation between "perlite roof insulation" and "perlite-base roof insulation" although the proposed ASTM Standard clarifies the difference in recognition of different physical characteristics. The difference is in the total quantity of allowable organic fibers in the two products and maximum water absorption properties. The contractor community is learning to distinguish between the two materials, and joint testing between the manufacturers of perlite roof insulations and NRCA/MRCA were undertaken, to determine how the differences affected field installation techniques. It was determined that subtle changes in the product brought about by the use of recycled paper products in the manufacturing process had indeed changed some of the handling properties of the perlite and perlite based roof insulation boards. The materials seemed to take on moisture more readily, but also appeared to release moisture from within the boards more readily than previously believed. New recommendations for application techniques for perlite and perlite-based roof insulation boards will be forthcoming based on recent field and laboratory testing.

It has indeed been an interesting period, and as changes become necessitated either by regulation or by new product developments, the industry can certainly look forward to new challenges in the manufacture, design, and installation of roofing assemblies. It will be a difficult time for those who will not learn or will not change to adapt to the new way in which things must be done. The industry can also look forward to unanticipated "problems" as a result of forced changes, since it is impossible to see all the curves coming.