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A Coordinator's Vision

by Walt Rossiter and Edward Kane

ROOFING MATERIALS AND SYSTEMS

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1. INTRODUCTION

Membrane and other low-sloped roofing systems are one of the key components of commercial and industrial buildings, and their satisfactory performance contributes greatly to successful building performance. Historically, low-sloped roofing has been one of the most problematic building components. Not only do premature failures resulting in leaks place the roof itself in jeopardy due to material deterioration, but also the consequential damages of leaks can be quite costly both in repair and rehabilitation of interior building components, and perhaps in time lost if sections of the building are rendered unusable until the leaks are repaired. On the positive side, major strides to improve performance have been taken by the industry over the past two decades, both in the materials and in the application practices used to construct the systems. At the same time, considerable research has been conducted to further the understanding of roof system performance. The result has clearly been that performance today is much improved over that of two decades ago. Such efforts are expected to continue in the years ahead as a need still exists to further the understanding of roofing performance.

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Many diverse roofing materials and systems are used for commercial and residential buildings. Remaining watertight is critical to successful building performance.

2. NEAR-TERM TRENDS

2.1 Materials for Commercial and Industrial Roofing

The majority of the roofs of commercial and industrial buildings are waterproofed with membrane roofing systems. Membranes used for roof construction consist of bituminous built-up roofing (BUR) using oxidised bitumen, polymer-modified bitumens, and the synthetic single-layer sheets based on polymers such as poly(vinyl chloride) (PVC), ethylene propylene diene terpolymer (EPDM), chlorosulfonated polyethylene (CSM), and thermoplastic olefins (TPO). Additionally, sprayed-in-place polyurethane foam and architectural metal systems are used. With the exception of TPOs, these materials and systems have been used by the roofing industry for more than two decades. There are regional preferences around the globe, but specific figures for the different countries are not available.

In the near future, these same membrane systems will continue to dominate the commercial and industrial market, and the introduction of new major membrane products is not foreseen. Regionally, some shifts in material usage may occur, and the use of TPOs, which is relatively new to the industry, may experience some increase in use. Not all changes in materials use will be necessarily motivated by efforts to improve roofing performance or reduce roofing costs. For example, environmental concerns

may place pressure on the industry to initiate changes such as decreasing the use of chlorinated materials, or systems whose installation requires solvent-bearing components or heated bitumens.

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Application of a tape adhesive to form a seam of an EPDM membrane. The use of tape-adhesives in lieu of liquid adhesives for EPDM provides an example of applying advances in technology to improving the performance of existing roofing.

Although the types of membranes materials and systems may not change drastically, it is not unexpected that formulations, special features, accessory items, or installation practices specific to a given system may change considerably as the result of efforts to improve performance, reduce costs, or affect some other aspect such as impact on the environment. That is, there will be movement towards the development of "high performance roof systems," which are those displaying, in comparison to today's roofing, increased wind and fire resistance, longer service life and lower life cycle cost, and improved energy efficiency among other characteristics. A notable example from the United States is the use of tape to bond the seams in EPDM membranes in lieu of solvent-based liquid adhesive systems. Before the decade is over, tape-bonded seams may far surpass liquid adhesive-seams of EPDM roofing.

2.2 Type of Construction

Re-roofing dominates the roofing market now and will do so in the years ahead. This fact has technological implications as two paths may be followed when an existing roof reaches the end of its service life. The existing roof may be replaced, or it may be re-covered - which is the term applied to installing a new membrane system directly over the existing one. Historically, the former choice was generally made, because removal of the existing materials assured that the new construction would not be placed at risk by material-damaging moisture that was, in all likelihood, present in the old roof system and might possibly be trapped by the new membrane. In the years ahead, more consideration will be given to re-cover in lieu of replacement, particularly because of the increasing costs of disposal of the materials removed from the existing roof. However, re-covering should not proceed without an understanding as to whether moisture trapped in the re-covered roof will have an opportunity to dry before possible damage to the new system occurs. In recent years, research has indicated that roof systems can dry when re-covered, if entrapped moisture can be dissipated through the roof deck into the building space. It is expected that re-cover of existing roofing will grow as the industry develops guidelines for avoiding problems generated by entrapped moisture.

2.3 System Performance

The decade of the 90s has been one of stability for the roofing industry and, as mentioned, little change in material selection for membrane roofing is expected in the near future. This provides opportunity for the industry to devote research and development efforts to furthering the understanding of the performance of the current systems and to developing solutions that overcome their limitations. As in the past, improving the durability of membrane roofing will be important. In particular, it is imperative that the performance of roof systems subjected to catastrophic natural events such as hail and windstorms be enhanced. For example, in recent years in many parts of the world, large economic losses have occurred due to the poor performance of roofing systems in hurricanes and related windstorms. Near-term research efforts will be committed to developing design and installation guidelines, based on sound engineering principles, for the selection of roofing systems having improved wind uplift resistance.

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Total destruction of a membrane roofing system due to hurricane-force winds. Future efforts will be aimed at developing design and installation guidelines for roof systems that can resist such destructive wind forces.

2.4 Sustainable Roofing

Sustainable roofs are those that are not only durable, but are also energy and cost efficient, and environmentally friendly over their life-cycle. An increased awareness of sustainable roofing issues on the part of designers, manufacturers, and contractors will be seen in the coming years. Expectations are that sustainable roofing concepts may begin to be employed, though probably only to a limited extent in the near future. Guidelines and design criteria for sustainable roofing need to be further developed to allow for total implementation. Practices for sustainable roofing vary from country to country around the world, or even between different regions within a country. Because of the importance of this issue, CIB Working Commission W83 on Roofing Materials and Systems, jointly with RILEM Technical Committee RMS, has undertaken a task to assess the state-of-the-art of sustainable roofing by conducting a review of design, application, and maintenance practices used throughout the world. The work is planned to be completed in about four years when a report will be published.

A number of specific topics expected to have impact on the roofing industry in the near future may be found under the umbrella of sustainable roofing. Among them are:

- The recycling of roofing materials. Not only is this issue being driven by landfill needs recycled materials do not have to be disposed of- but also by material conservation demands. Re-cycling of roofing materials will only grow in the years ahead. As an example of the extent to which recycling may be implemented and its impact, the Swiss presently recycle plasticised PVC roofing, which accounts for over 25 % of membrane roofing in Switzerland.
- Green roofing (e.g., roof gardens). In urban areas of some countries, particularly in Europe, the installation of green roofs has become a common contributor to the improvement of the environment. The practice may become more wide spread, particularly if design and installation guidelines developed to date are transferred to regions that have yet to implore green roofing to any serious extent.
- Environmentally-friendly products. The industry will continue efforts to develop products and application procedures that are more friendly to the environment. Examples include alternative blowing agents to replace the hydrochlorofluorocarbons (HCFC) used in the manufacture of cellular plastic (i.e., foam) insulations, and replacement of volatile organic compounds used in adhesives or as cleaning agents during in roof installation.
- Regulations In some countries. Stringent environmental regulations have been implemented, and are expected to remain in place. However, it has been recognised that, in some cases, regulations can be too tough and have serious negative economic impact. The result of such recognition may be a search for a balance between environmental and economic needs. In areas where few environmental regulations exist, they may be put into place as part of trends to develop practices that respect the environment.

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Roofing construction is labour intensive and a strenuous occupation. The labour pool is shrinking and, consequently, improved ways for attracting and retaining workers is an important industry issue.

2.5 Installation and Labour

In many parts of the world, the labour pool dedicated to roofing is shrinking and will continue to do so in the future. The result will be an increase in roof installation costs and a demand for systems which minimise labour requirements. To render the shrinking labour force more efficient, training programs may become more sophisticated. Although automation may help alleviate labour shortages, to date, efforts to automate job-site roofing practices have been essentially non-existent.

The problems in attracting and retaining workers are partially the result of the declining number of people in the age group that is most suitable for roofing work, in conjunction with ageing of the current work force. Another factor is that roofing work is at a disadvantage with many other occupations. It is

strenuous and greatly affected by the weather - when the weather is unsuitable, the worker suffers loss of income. The consequence is that better ways for attracting workers into the industry, as well as retaining them once they arrive, will be sought.

2.6 Standardisation

A major advancement expected in the field of standardisation is that, in Europe, the CEN roofing standards currently under development should be issued, and gradually implemented. They will replace national standards previously developed by individual European countries.

2.7 Safety

In recent years in some parts of the world, particularly the United States, worker safety has been one of the dominant issues in the industry. Government agencies have proposed or set worker-safety regulations that are considered overly restrictive by the contracting community. The issues, which include fall protection, exposure to asbestos-containing materials, and exposure to asphalt fumes, have been controversial and often confrontational between the involved parties. It is hoped that, in the future, cooperative joint programs may be set up to resolve such issues through implementation of non-regulatory voluntary safety programs.

2.8 Total Quality Management (TQM)

Total quality management (TQM) programs have been implemented in the roofing industry, with the extent varying considerably on a regional basis. At present, the manufacturing segment of the industry has been more involved than other groups, and a number have participated in TQM programs such as ISO 9000 accreditation. Awareness of the benefits of TQM will spread in the near term. Expectations are that more manufacturers and roofing contractors will take part in TQM programs.

2.9 Roofing Research

The need for roofing research to enhance roofing performance will remain a high priority in the roofing industry. For example, in late 1994 in the United States, the Civil Engineering Research Foundation (CERF) issued a report, "Materials for Tomorrow's Infrastructure: A Ten-Year Plan for Deploying High-Performance Construction Materials and Systems." The U. S. Roofing Industry participated closely in the development of the report, and recommended a ten-year research plan for roofing. The plan covered a wide range of topics including assessment of service life, development of improved diagnostic methods for performance assessment, development of improved criteria for wind and hail resistance, formation of a single-source data base on roofing technology, and creation of a national roofing research center.

Although roofing research will continue to play a vital role in improving roofing performance, the manor in which some research will be maintained will shift in the years ahead. Traditionally, government agencies around the world have supported much of the basic and applied research that has been the corner stone of increasing our understanding of roofing performance. The manufacturing segment has focused research on developing new products and solving system specific problems associated with existing products. It is well known that budgets for government agencies have decreased in recent years. Among the impacts is that less public money is available to finance roofing research studies. This situation is not expected to change significantly in the near future. To compensate to some degree for the reduced public funding, it is envisioned that industry and government will form cooperative research consortia to solve roofing's most pressing global problems. Such joint research can be quite beneficial in solving major industry issues as the collective knowledge base and experiences of the involved parties far exceeds the contributions of any individual organisation.

Research into mechanisms by which computer technology can be better put to use for improving roofing performance as well as disseminating knowledge will be initiated. To date, the roofing industry's use of computer technology has been somewhat limited to proprietary functions such as computer-aided design

of drawings and details, availability of guide specifications, or record keeping. Some design and construction manuals have also been made available in electronic form. Presently, concepts are emerging in the construction industry on the development of universally accessible electronic media for the dissemination of data, information, and knowledge. Such systems have been termed computer-integrated knowledge systems. Participation of the roofing industry in the formation of these systems is certainly foreseen.