Report on the RCI Foundation Roofing Research Summit

By James L. Hoff

EDITOR'S NOTE: This report was given at the 25th International Trade Show and Convention, March 25 - 30, 2010, in Orlando, FL, and published in the Proceedings *of the convention.*

INTRODUCTION

As part of its continuing mission to promote building envelope research, the RCI Foundation sponsored a Roofing Industry Research Summit on May 1 and 2, 2009, at the Marriott Wardman Park in Washington, DC. The summit was convened following the conclusion of the Symposium on Building Envelope Sustainability sponsored by the RCI Foundation (RCIF), Oak Ridge National Laboratory (ORNL), the National Institute of Building Sciences (NIST), the Building Enclosure Technology and Environment Council (BETEC), and National Research Council Canada (NRC).

The primary goal of the summit was to develop a broad vision for roofing research, encompassing all major roofing configurations: both low-slope and steep-slope roof systems, as well as the wide variety of modern roofing materials used to construct these systems. In addition, this research vision should address all major demands being placed on modern roofs, including energy efficiency, renewable energy production, water management, material management, durability, and life-cycle management.

The key objectives of the summit were to

- Identify the major influences affecting the roofing industry over the next decade, as well as the risks and opportunities these influences pose,
- Identify the critical research questions and topics needed to address these opportunities and risks, and
- Establish an ongoing program to organize and fund this research, as well as to monitor and report on progress.

SUMMARY OF KEY ROOFING RESEARCH ISSUES

Issue 1: The Roof as Platform

New roofs are increasingly being used as platforms for a variety of functions they have not necessarily been designed to accommodate. As energy needs grow, the nation is looking to the existing roofing stock as a solution for deploying new technologies. As a result, new influencers, such as the mechanical, electrical, and landscaping trades, are having a greater impact on design, application, and maintenance of roofing systems.

Issue 2: New Demands on Buildings

New demands on buildings may lead to new challenges for the roof and the security of the entire building. Tighter building enclosure techniques may tend to drive moisture through the roof, and the increasing use of vegetative and PV technologies may also present new challenges to the performance of modern roofing systems.

The push toward more energy-efficient buildings may require "smarter" roofing technologies that can contribute to heat energy capture and other savings, while the introduction of new energy codes may require a significant increase in the *in-situ* investigation of new roofing and building systems to validate performance and avoid unintended consequences.

Issue 3: The Challenge of Durability

As new demands for rooftops emerge, and as the pace of technology change accelerates, traditional approaches for defining and measuring roof system durability may not be adequate to assure that the rooftops of tomorrow will deliver the durability expected from truly sustainable building systems. Historically, the roofing industry has relied upon long-term field performance to assess the durability of roof systems; but this approach becomes problematic when new demands, new technologies, and new products are rapidly being introduced into the market.

In order for the roofing industry to fulfill its responsibility to define and measure roof system durability, new research approaches must be developed. Examples of research alternatives may include new predictive modeling tools and total quality management (TQM) processes. In addition, new areas of research involving the repairability and renewal of existing roof systems need to be explored in order to maximize effective roof system service life.

Issue 4: The Evolving Role of Roofing Standards

New standards for sustainable buildings are being developed that may conflict with current roof design knowledge and best practices. Although the roofing industry continues to develop and refine roof performance standards, there appears to be a lack of effective coordination between roofing standards and emerging standards for sustainable buildings.

While interest in sustainable roof systems is increasing dramatically, there are currently no standards addressing roofing sustainability beyond singular characteris-

PARTICIPATING ORGANIZATIONS

ARMA	Asphalt Roofing Manufacturers Association
CEIR	Center for Environmental Innovation in Roofing
CFFA	Chemical Fabrics and Film Association
CIB	International Council for Building Research Studies and Documentation
CRCA	Canadian Roofing Contractors Association
CRRC	Cool Roof Rating Council
CSSB	Cedar Shake and Shingle Bureau
ERA	EPDM Roofing Association
FM	Factory Mutual
GRHC	Green Roofs for Healthy Cities
IBHS	Institute for Business and Home Safety
MRA	Metal Roof Association
NRC	National Roofing Council (Canada)
NRCA	National Roofing Contractors Association
ORNL	Oak Ridge National Laboratory
PIMA	Polyisocyanurate Manufacturers Association
RCI	RCI, Inc.
RCIF	RCI Foundation
RCMA	Roof Coating Manufacturers Association
RICOWI	Roofing Industry Committee on Weather Issues
SPRI	Single Ply Roofing Industry
TRI	Tile Roofing Institute

tics such as roof reflectivity. This may lead to deselection of some otherwise highly suitable roofing solutions, resulting in the selection of roofing systems that may actually be less sustainable over the long term. In addition, the lack of clear sustainable roofing standards may create confusion in the design and research community.

Issue 5: Industry Practices and Knowledge Base

As building technology accelerates, regulations affecting roofing are often complex, confusing, and conflicting. Because building technology is being driven increasingly by larger societal needs, there may be many conflicts between emerging building technologies and the established fundamentals of good roofing practice.

At a time when understanding of good roofing practice is becoming more important, the knowledge base of the roofing industry is increasingly neglected. The industry is quickly losing key researchers, educators, and technical experts to retirement. Current communication efforts are scattered and fragmented, and available roofing information is not properly distilled for nonroofing audiences. Industry groups that could take a lead communications role, such as CIB/RILEM, are underfunded and rely on volunteers for day-to-day tasks.

A Special Note on Sustainability

Many definitions of sustainability include a combination of environmental, economic, and social factors. Although the social functions and impacts of the built environment are very important, developing a research agenda for these issues lies beyond the expertise of the members of the Roofing Industry Research Summit, who for the most part are experts in engineering, technology, and other physical sciences. Accordingly, for the purposes of the Summit's mandate, building and roofing sustainability is addressed as it relates to issues of durability, resource consumption, and economics but not to social or cultural issues.

Formation of Key Research Task Groups

In an effort to address these key issues, the Roofing Industry Research Summit has organized individual task groups to identify the highest priority research strategies for each key issue. These task groups and their members are as follows:

Task Group 1: Roof as Platform

- Bill Waterston, RCI (leader)
- Joe Wilson, RICOWI
- Jim Kirby, NRCA
- Scott Kriner, MRA
- Jerry Vandewater, TRI
- Rick Olson, TRI

Task Group 2: New Building Demands

- Stan Graveline, CFFA (leader)
- André Desjarlais, ORNL
- Jim Jannasch, ERA
- Peter Kalinger, CRCA
- Tony Bonura, CSSB
- Tom Hutchinson, RCI
- Richard Cote, GRHC
- Bas Baskaran, NRC
- Lorraine Ross, PIMA
- Mike Ennis, SPRI
- Bill Collins, CEIR

Task Group 3: Roof System Durability

- Mike Ennis, SPRI (leader)
- Walt Rossiter, RCI
- Lorraine Ross, PIMA
- Jim Hoff, CEIR
- Cary Black, CFFA
- Richard Cote, GRHC
- Rick Olson, TRI

Task Group 4: Roofing Standards

- Helene Hardy Pierce, RCIF (leader)
- Phil Smith, FM
- Wanda Edwards, IBHS
- Sherry Hao, CRRC
- Rick Olson, TRI
- Allen Weidman, ARMA
- Ralph Paroli, NRC

Task Group 5: Industry Practices

- Jim Hoff, CEIR (leader)
- Jean-Guy Levaque, RCIF Canada
- Jim Baker, RCMA
- Richard Cote, GRHC
- Keith Roberts, CIB
- Mike Russo, observer
- Walt Rossiter, RCI

FINDINGS AND STRATEGIES

ROOF AS PLATFORM (TASK GROUP 1)

Industry Influencers

1. New roofs are increasingly being used as platforms for a variety of functions they have not necessarily been designed to accommodate. This is creating problems and questions on proper roof design going forward.
2. As energy needs grow, the nation is looking to the existing roofing stock as a solution for deploying new technologies.
3. Outside influencers, such as the mechanical and electrical trades, are having a greater influence on design, application, and mainte-

nance of roofing systems.
4. New energy codes and standards demand a better integration of roofing into a whole-building energy analysis. One current standard does not even identify the roof as part of the building envelope.

Critical Research Agenda

1. Develop a Design Guide that includes low-slope roofing best practices to better accommodate the new nonroofing equipment and technologies being installed on today's new roofs.
2. Conduct a study of existing whole building energy analysis models, with the goal of identifying a model that better integrates roofing into the building envelope.
3. Review various incentives that promote national, state, and local energy policies for use when roofs are retrofitted or replaced.
4. Tap into existing knowledge from nonroofing stakeholders (equipment, solar, communications) on integrating their new technologies and equipment into properly designed roofs.

NEW BUILDING DEMANDS (TASK GROUP 2)

Industry Influencers

1. Tighter buildings and superinsulation techniques are literally driving heat, moisture, and air into the roof assembly. This requires more thoughtful research on moisture management.
2. The push toward net-zero energy buildings demands "smarter" roofing technologies that contribute substantially to that vision. The development of scientifically unsupported codes, standards, and rating systems may lack consideration of important roof-system performance attributes.
3. The impact on the performance of modern roofing systems of emerging technologies such as vegetative roofs, rooftop photovoltaics, and others is not fully understood.
4. There is increased attention on global warming, greenhouse gas emissions, and other environmental influences.

Critical Research Agenda

1. Collect data on the *in-situ* performance of roof systems and their impact on building performance.
2. Develop and validate roofing models capturing all of the necessary performance parameters.
3. Study emerging systems such as vegetative roofing and renewable energy options and their impact on roof system performance and contribution to sustainable construction.
4. Initiate research on topics such as heat-energy capture, variable reflectance, and/or variable emittance membranes, "smart" vapor retarders, and self-drying roofs.
5. Develop dynamic simulations and test protocols that more closely approximate *in-situ* performance.

ROOF SYSTEM DURABILITY (TASK GROUP 3)

Industry Influencers

1. Roofs are increasingly being used as platforms for a variety of new functions they have not necessarily been designed to accommodate. The impact of using the roof for these new functions is largely unclear. The durability of the roof system may be compromised, or it may be enhanced.
2. The roofing industry currently lacks the resources (finance, people, organization) to address key research questions, especially questions regarding durability. Perception of roofing technology has hindered interest in research.
3. New technologies and new building energy goals may affect roof-system performance, especially in regard to increased heat and moisture impacts.
4. The development of roof system standards has not kept pace with new demands and new technologies that impact roof system durability.

Critical Research Agenda

1. Develop and implement a durability assessment protocol for roof systems combining historical *in-situ* performance data, small-scale testing, and predictive modeling.
2. Develop and implement a process-based approach to roof system durability, emphasizing increased collection of field performance data, systematic analysis of deficiencies, and the implementation of continuous improvement strategies.
3. Investigate and develop technologies and strategies to extend service life through periodic maintenance and repair or replacement of critical roof system components.
4. Develop performance criteria for a roof with a minimum expected service life of 50-years, including repairability and retention of key properties over the lifetime of the roof.

ROOFING STANDARDS (TASK GROUP 4)

Industry Influencers

1. Energy organizations and public agencies across the world are seeking dramatic increases in building-energy efficiency, including up to 50% efficiency increases in overall energy use as well as zero-energy buildings. The roofing industry must provide the guidelines and standards for the emerging technologies that will fulfill these goals.
2. Increasingly, nonroofing industry influencers are creating and mandating standards that conflict with current roof design knowledge and best practices.
3. The test methodologies for ASTM standards governing roofing material performance need to be in line with real-world performance criteria.
4. The amount of raw data collected on roofing materials and system performance is increasing exponentially, but it must be comparable and based on good science instead of rhetoric.
5. The definitions, limitations, and actual standards used to collect the above data lack a singular methodology and weighting system. This is creating confusion in the design and research community.
6. The desire for sustainable roof systems is increasing dramatically. Unfortunately, there are currently no standards governing sustainability beyond singular characteristics such as roof reflectivity. This leads to deselection of some high-performance roofing solutions and the specification of roofing systems that may actually be less sustainable over the long term.
7. Enhanced fire, wind, and hail resistance is being required by code bodies and insurers, including FM Global. However, there are currently no standards defining the correlation between disaster-resistant roofing systems and sustainable, long-term roofing solutions.
8. When standards-writing bodies and policymakers like ASHRAE and ASTM introduce new building-design standards, roofing is not given priority consideration unless the standard is under the jurisdiction of a roofing-related group.

Critical Research Agenda

1. Create standards that address durable roofing construction via a set of durability metrics, inclusive of long-term performance criteria and goals.
2. Develop a standards-writing effort that incorporates a decision analysis of competing needs when it comes to fire, wind, and hail resistance versus

long-term roof system performance, including those involving emerging technologies.

3. Undergo an overarching research and standards-writing effort that will allow contractors, designers, and end-users to make educated, consistent, and comprehensive decisions about roofing systems.
4. Encourage best practices or "harmonization" of the above standards to include test data and analysis that offer repeatability by a variety of testing agencies.
5. Integrate existing codes and standards with emerging roofing technologies.
6. Define the relationships between the roof system and other building components to help guide policymakers when they are creating new building design standards that impact the roofing industry.

INDUSTRY PRACTICES (TASK GROUP 5)

Industry Influencers

1. The roofing industry is quickly losing key researchers, educators, and technical experts to retirement. It is critical that this knowledge base is not lost.
2. New regulations are often complex, confusing, and conflicting. The roofing industry needs to keep the messages simple and consistent.
3. Current communications efforts are scattered and fragmented.
4. Roofing technology is being driven by a combination of societal as well as technical needs.
5. There frequently is a disconnect between emerging technologies and the basic fundamentals of good roofing practice.
6. Information on roofing technologies is vast and not properly distilled for nonroofing audiences, such as architects and property owners/managers.
7. Industry groups that could take a lead communications role, such as CIB/RILEM, are underfunded and rely on volunteers for day-to-day tasks.

Critical Research Agenda

1. Develop an international coalition of roofing and related specialists that serves as a central industry voice and has strong credibility that will lead to buy-in from other industry-related organizations.

2. Develop research leading to the creation of an international reference and knowledge database for roofing
3. Establish a peer-review process to review, edit, and approve information going into the central database
4. Clearly and consistently communicate this knowledge through a central industry voice
5. Develop a willingness among other industry groups to receive this information by creating an authoritative and global industry voice.

6. Disseminate this information effectively by using Building Information Transfer (BIT) technology or similar techniques
7. Present a funding proposal for the creation of this central industry voice and database.

James L. Hoff

Jim Hoff is an experienced executive in the building materials industry, with over 30 years of service in both the public and private sectors. Dr. Hoff currently serves as research director for the Center for Environmental Innovation in Roofing and as president of TEGNOS Research, Inc., a research and consulting organization dedicated to expanding understanding of the building envelope. Jim is also a board member of the RCI Foundation and served as chair for the 2009 Roofing Industry Research Summit.