

Thermal Performance of the Exterior Envelopes of Whole Buildings XIII Clearwater Beach, FL – December 4-8, 2016

Workshop Schedule

SUNDAY, DECEMBER 4TH

Workshop 1: Performance of Air Barrier Systems

Ballroom – Beach

Laverne Dalglish – Executive Director, Air Barrier Association of America

9:00 AM – 9:45 AM	Whole Building Testing – John Straube
10:00 AM – 10:45 AM	Energy Savings Calculator – Andre Desjarlais
11:00 AM – 12:00 PM	Air Barrier Issues in the Field – Brian Stroik
1:30 PM – 2:15 PM	Questions We Need Answers For – Laverne Dalglish
2:30 PM – 3:15 PM	Air Barrier Installation Inspections – Peter Spafford
3:30 PM – 4:15 PM	Measuring Water Resistance – Sara Flock
4:30 PM – 5:15 PM	Design Professional and Air Barriers – Andrew Dunlap

Workshop 2: Thermal Mass Workshop V

Ballroom – Gulf

Dr. Jan Kosny – Director, Building Enclosures and Materials, Fraunhofer Center for Sustainable Energy Systems, CSE (Massachusetts)

Since 2001, a group of building scientists, architects, and researchers has been meeting during the Thermal Performance of Exterior Envelopes Conference to discuss current research and new application trends in the areas of thermal storage and thermal stability of buildings.

A modern "massive building" is one which can utilize thermal excitations from the exterior environment to improve overall energy efficiency, manage the building's peak energy demand, and facilitate the coordination of the building's energy consumption with solar energy generation and electric power grid dynamics. Significant energy-savings are possible by blending thermally massive building envelopes with natural elements such as sunlight, temperature fluctuations, breezes, and appropriate landscaping. When properly combined, these elements produce a building with less reliance on purchased energy, less environmental impact, and improved thermal comfort.

Today, building designs that utilize either conventional thermal mass or phase change materials are receiving wider acclaim due to both energy cost concerns and the increasing interest in the environmental impact of buildings.

The following sessions will be offered during the whole-day workshop on Sunday, December 4th:

8:00	Introduction	Dr. Jan Kosny – Fraunhofer CSE and Marc Lafrance – U.S. Department of Energy, Building Technology Office (DOE BTO)
8:15	Infinite R	Gary Gray – Owner, Applied Innovation Group
8:35	Low Energy Buildings - Why Thermal Mass?	
8:40	Managing the Unavoidable – Implications of climate change and thermal mass in federal buildings	A.R. Ann Kosmal FAIA – Office of Federal High-Performance Green Buildings, U.S. General Services Administration
9:00	U.S. and European Union priorities and strategies in the area of building energy efficiency	Marc Lafrance – DOE BTO
9:20	Hot Time – Thermal mass technologies for climate change adaptation and evolving building energy codes	A.R. Ann Kosmal FAIA – Office of Federal High-Performance Green Buildings, U.S. General Services Administration
9:50	Typical durability problems in massive stone, concrete, and masonry applications	Prof. Dariusz Gawin – Dept. of Civil and Architectural Engineering, Lodz Technical University
10:20	Break	
10:30	New Developments in PCM Materials	
10:40	Cool Composites – Inorganic PCM encapsulation and integration into Polyurethane	Dr. Changqiong Zhu – Lead Scientist, Cool Composites
11:10	Microtek Labs – Manufacturing of microencapsulated PCMs	Tim Riazzi – President, Microtek Labs
11:40	Phase Change Energy Solutions – New high performance PCM for building applications	Dr. Reyad Sawatta – Chief Scientific Officer, Phase Change Energy Solutions
12:10	Infinite R – Thermal performance testing of macro-packaged PCMs	Gary Gray and Dr. David Yarbrough
12:30	Lunch Break	
1:30	Overview of PCM Testing Methods	
1:35	Short review of PCM testing methods	Dr. Jan Kosny – Fraunhofer CSE
1:50	DSC testing method and introduction of the step method	Dr. Nitin Shukla – Fraunhofer CSE
2:10	Introduction to the Heat Flow Meter Apparatus (HFMA) testing method	Dr. David Yarbrough – Vice President, R&D Services, Inc.
2:30	NEW ASTM C1784 Standard	Dr. Nitin Shukla – Fraunhofer

		CSE and Dr. Kaushik Biswas – ORNL
2:50	Dynamic hot-box testing	Dr. Jan Kosny – Fraunhofer CSE
3:20	PCM Field Testing – Objectives and Limitations	Dr. Kaushik Biswas – ORNL
3:50	Break	
4:00	Modeling of PCMs in Buildings	
4:05	Most popular thermal and whole building energy simulation tools	Dr. Jan Kosny – Fraunhofer CSE
4:20	Whole building PCM modeling with EnergyPlus	Dr. Paulo Cesar Tabares-Velasco, Assistant Professor, Dept. of Mechanical Engineering, Colorado School of Mines
5:00	Discussion of need for formation of North American PCM Manufacturers Association	All workshop participants

Workshop 3: Heat, Air, and Moisture in Buildings – Problems and Solutions
Ballroom – Palm

Dr. Wahid Maref – Professor, École de Technologie Supérieure (Quebec)

The workshop will cover Heat, Air and Moisture in Buildings. The speakers will cover everything from fundamentals to practice by presenting case studies or/and by modelling and field experiment in order to assess the hygrothermal performance of the building envelopes. Building envelopes are becoming increasingly insulated due to more stringent energy requirements around the world, whether in new construction or by adding insulation to either the interior or exterior of existing buildings. As such, interstitial condensation, thermal bridges, and other physical phenomena are becoming an issue for building energy performance and durability. In-situ thermography techniques, guidelines, and calculation techniques for European Standards are presented in this workshop to help assess the impact of thermal bridges on the overall heat loss due to poor design, standard practice, etc.

New sensors technology for roofing applications will also be presented, including live monitoring results. This includes practical applications and installation details of the sensors added during various stages of the building life cycle, including new construction, existing buildings, and site condition assessments.

- Thermal Bridges — N. Van Den Bossche
- Structure Monitoring: Making the Invisible Visible — J. Teetaert
- Impact of Fenestration on the Overall Thermal Performance of the Building Envelope — Mario D. Gonçalves
- Modern Hygrothermal Engineering: Motivation, Basics, Examples – Manfred Kehrler

Speaker #1:

Nathan Van Den Bossche – Professor, Department of Architecture and Urban Planning, Ghent University (Belgium)

Title: Thermal bridges: calculation, criteria, impact and practical implementation

Abstract: As we are moving towards better insulated building envelopes, the relative impact of thermal bridges increases as well. For well-insulated buildings the share of thermal bridges can add up to over 20% of the overall transmission heat loss. More and more countries are implementing restrictions on the occurrence of thermal bridges, but this often introduces a number of both technical and practical questions to be answered. How to interpret existing calculation procedures? How can we find a trade-off between technical detail and practical feasibility? How to apply standards on steel-frame constructions?

This workshop addresses the following topics:

- Calculation: to what extent can we simplify certain layers and local effects?
- How to calculate steel-frame constructions? Should we simulate tolerances, imperfect contact, and every screw or bolt?
- Subsequently, a set of criteria is presented that allows both a detailed (numerical) as well as a rule-of-thumb approach
- The impact of thermal bridges on the overall heat loss is then analyzed for poor design, standard practice, and state-of-the-art solutions

Speaker #2:

Alistair Kuegler – V.P. Business Development, Structure Monitoring Technology (Canada)

Title: Structure Monitoring – Making the Invisible Visible

Abstract: Leading edge structural monitoring technology is commercially being applied in the investigation of building wall and roof performance. The practice uses sensors embedded in the assembly where we cannot easily inspect for moisture content, condensation, dew point, thermo profiling, vapor pressure, differential air pressure, or building component movement.

The initial commissioning and verification of design details is key for design professionals in continuing to develop “best practice” guidelines and tolerances for the modern construction environment. Building owners and operators are interested in knowing whether remediations or renovations are progressing as planned on existing buildings.

The workshop will outline sensors and monitoring platforms in data logging and real-time reporting configurations to verify assembly conditions. Case studies of installed sensors added during various stages of the building life cycle, including new construction, existing buildings, and re-commissioning of membrane components will be discussed, as well as real-life, practical applications, installation details, site condition assessments, and live monitoring results.

Speaker #3

Mario D. Gonçalves, P.Eng. – President, CLEB Building Science (Canada)

Title: Impact of Fenestration on the Overall Thermal Performance of the Building Envelope

Abstract: Windows, and metal and glass curtain walls generally represent 50 to 100% of the exterior cladding of large buildings, and are a determining element in a vertical building envelope's performance. They are often an important architectural feature of a new building and represent a significant portion of its overall cost. As a determining element in the performance of the vertical building envelope, windows and curtain walls must be air and water tight, prevent condensation from occurring on the interior surfaces, and resist wind load and other exterior forces acting on the building envelope.

The energy efficiency of buildings is a key technological and economic challenge facing the construction industry and the new NECB requirements will necessitate changes to the design and construction of fenestration products, particularly metal and glass curtain walls. The current minimum prescriptive requirements for windows remain well within attainable limits, leaving room for improved performance. However, the new thermal performance requirements for the non-visual portion of metal and glass curtain walls are expected to have similar performance to that of opaque walls. Given the effect of framing, attaining such thermal performance is currently practically impossible with the current construction methods and materials, forcing designers toward the performance compliance path.

Considering that most of the energy lost through the vertical building envelope will be through the weakest component, the overall thermal performance will depend largely on the thermal performance of the fenestration, particularly when opting for the maximum window-to-wall ratio permitted through the prescriptive compliance path.

Speaker #4

Manfred Kehrer – President, JustSmartSolutions (Tennessee)

Title: Modern Hygrothermal Engineering – Motivation, Basics, Examples

Abstract: Today's building enclosures are more energy efficient than decades ago, mainly due a higher level of insulation and air tightness; however, the downside is an increased risk of moisture problems with potential structural failure and unhealthy conditions. Modern hygrothermal engineering has already made its way from science to engineering and is an important tool today for design education and forensic analysis. Motivation, basics, and examples will be shown.

Workshop 4: Insulation Materials and Systems 2.0

Ballroom – Palm

Hartwig Kunzel, Ph.D. – Head of Group, Fraunhofer IBP (Germany)

Andreas Holm, Ph.D. – Director, FIW Munich (Germany)

André Desjarlais – Program Manager, Oak Ridge National Laboratory (Tennessee)

What are the trends in building insulation? How do new systems perform and how durable are they? Where are the limits? We need to appreciate the dependence of thermal performance on temperature, humidity, and air flow. What are the pitfalls of testing and evaluating the thermal properties of insulation systems? We will discuss appropriate protection and maintenance

measures to ensure long service life of insulated building assemblies, and learn about the recycling options for insulation materials and systems.

Workshop 5: How to Evaluate the Risk of Mold Using the Mold Growth Index

Ballroom – Bay

Tuomo Ojanen – Senior Scientist, VTT (Finland)

This workshop will present the Mold Growth Index (MGI) model, its application and how it has been used for decades in Europe. It will also explain:

- How it was developed and which factors influence the risk of mold
- Evaluation of critical mold growth levels in structures
- The assessment criteria and how these relate to MGI
- The parameters used in the numerical model and what they represent
- Examples of how MGI is used and how the result will vary for different materials

In addition, the type of materials tested to define a numerical model will be presented, and under what conditions. Finally, ongoing research will be discussed and whether further development of the numerical model is expected.

Workshop 6: Probability Assessment of Performance and Cost

Ballroom - Bay

Carl-Eric Hagentoft – Professor, Chalmers University of Technology (Sweden)

The IEA-EBC annex on Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost (RAP-RETRO) was finalized during the past year.

Retrofit measures are of the utmost importance for upgrading the existing building stock. As such, we need to design and realize robust retrofitting with low energy demand and life cycle costs, while controlling risk levels for performance failure. But, many building owners are only interested in the initial capital cost. Looking at actual risks in performance and the costs incurred highlights the need for life-cycle thinking.

In short, this annex provides decision support data and tools for energy retrofitting measures. The tools are based on probabilistic methodologies for prediction of energy use, life cycle cost and functional performance. A risk assessment framework has been developed and applied on case studies. The process of risk management and how to include probabilistic assessment tools during the building process will be explained, as well as exemplifications of how to write guidelines.

Some results from the annex will be presented, where after-group discussions will take place, and how to target and facilitate such analyses in the common practice both in projects related to new and existing buildings.

TUESDAY, DECEMBER 6TH

**Workshop 7: Building Science Education Update
Ballroom - Beach**

Samuel Taylor – Consultant, Energy & Resource Efficiency (Maryland)

An update and open forum will be provided on progress in implementing university building science education programs. The meeting will be followed by side meetings, during the week, seeking comments and input from Buildings XIII participants - particularly from North American and European university professors – on building science teaching resources and approaches.

The year 2016 begins with the NIBS Building Innovation Conference with the “Symposium on Building Science Education in North America” addressing solutions towards building science competency. It will be followed by presentations at Penn State expanding on “not so difficult” approaches for teaching building science fundamentals and the infusion of building science in traditional courses, as well as a forum addressing the pairing of experiential and academic learning.

The Joint Committee on Building Science Education and the BETEC Education Committee will provide updates on the implementation of these approaches and the use of new teaching resources (e.g., textbooks, modules, databases). Also, updates will be provided by DOE on the “Race to Zero” Student Design Competition; the new university section of the Solution Center, and progress in implementing the building science guidelines. For further information, see "Events" on <http://www.BuildingScienceEducation.net>.

AGENDA

The overviews will be kept brief supplemented by hand-outs and materials posted on BSE Update webpage. The primary objective of the meeting is to make progress on the task group projects/products, including arranging for input and side meetings at the BUILDINGS XIII Conference, and later.

- Brief Overview, Highlights of Year (Joint Committee, BETEC, etc.)
- DOE/PNNL brief overview; Request for BSE Solution Center Input and Peer Reviews
- Priority Near Term Joint Committee/BETEC Task Group Projects – Request for input and side meetings
 - Hygrothermal Analysis Guide overview (focus on RTZ audience)
 - Modules for infusion of building science into traditional courses, overview (input for slides/graphics, message flow, peer review)
 - Task Group Next Steps – address tentative schedule/actions
 - Scheduling of work on guide and modules
 - Peer Review
 - Testing guide and modules in classroom setting
 - Adaptation of guide and modules as an input to BSE Solution Center
- Adjourn to Reception (Island Ballroom) – and an opportunity for continuation of discussions

THURSDAY, DECEMBER 8TH

Workshop 8: US DOE and IEA Building Envelope Roadmap Ballroom – Beach

Sven Mumme – Building Envelope Technology Manager, Department of Energy (Washington, DC)

Marc LaFrance – Windows Technology Manager, Department of Energy (Washington, DC)

In 2014, the U.S. Department of Energy (DOE) Building Technologies Office's (BTO) published a [Windows and Building Envelope Research and Development Roadmap](#). The objective of the roadmap was to identify specific R&D targets and goals and define strategies to accelerate the development and deployment of cost effective envelope technologies. In FY17-18, BTO plans to update the roadmap to include a finer resolution of strategies to meet R&D targets and goals identified in the [DOE's 2016 Multi-Year Program Plan](#). The workshop is intended to engage key building envelope stakeholders from R&D community, manufacturers, and industry practitioners to gather input on the following:

- Domestic and global perspectives on advanced technology and goals (e.g. [IEA Roadmap](#))
- High priority opportunities in building envelope R&D
- Technical performance and cost metrics/targets to achieve BTO 2020-2030 goals
- Solutions and approaches to overcome critical technical challenges and market barriers

- 1:00 Introduction and Welcome: Marc LaFrance & Sven Mumme, US DOE
 - Participant introductions
 - Review of agenda and goal of the workshop
- 1:15 US DOE Building Technology Program Multiyear Plan, Global Perspectives: Marc LaFrance
 - Building sector performance goals
 - IEA Energy Efficiency Building Envelope Technology Roadmap
 - Current US DOE Envelope and Windows Roadmap
- 1:30 Window R&D Overview – Residential Integration Considerations: Marc LaFrance
 - Core laboratory work at LBNL
 - Competitively awarded projects
 - Market concepts for deep energy renovation in existing buildings
- 1:40 Building Envelope R&D Overview – Goals and Performance Metrics: Sven Mumme
 - Building envelope goals and opportunities
 - Envelope project portfolio overview
- 2:00 Stakeholder Discussion and Brainstorming on Opportunities and Relative Priorities
- 2:25 Breakout Group Assignments, Brainstorming, Input on Priorities: Marc & Sven
- 2:30 Breakout Groups on Opportunities, Targets and Metrics
- 3:20 Break
- 3:40 Breakout Group Reports, (by volunteer leads from each group) and discussion
- 4:10 Pareto Voting on Priorities
- 4:25 High Priority Activities
 - Suggested actions and next steps
 - Areas of responsibility, government vs private roles
- 4:55 Participants Complete Evaluation and Input Forms
- 5:00 Meeting Adjourns