

IAQ 2016
Defining Indoor Air Quality: Policy, Standards and Best Practices
Co-Organized by ASHRAE and AIVC
September 12 – 14, 2016
Alexandria, VA



Partner Organizations



ashrae.org/iaq2016

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Schedule for Sunday, September 11
Registration Hours: Noon - 5:00 pm
Speaker's Lounge: 2:00 pm – 5:00 pm
Welcome Reception: 5:00 pm – 6:00 pm

Updated August 18, 2016

Monday, September 12

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM – 8:30 AM	Opening session		
8:30 AM– 9:00 AM	Keynote Pawel Wargocki		
9:15 AM– 10:45 AM	Demand-controlled Ventilation: Assessment Methods and Potential	Approaches and Tools for Better IAQ	Characterization of IAQ Performance of Products and Systems 1
10:45 AM – 11:15 AM	Morning break		
11:15 AM – 12:15 PM	Climate change	International Urban IAQ (China & India)	The Policymaker’s Perspective: Exploring How Congress, the Federal Government, and States Strive to Improve IAQ
12:30 PM – 1:30 PM	Lunch		
1:30 PM – 2:00 PM	Keynote Chris Pyke		
2:00 PM – 3:30 PM	Residential 1	Where Are We Going with IAQ Metrics?	Characterization of IAQ Performance of Products and Systems 2
3:30 PM – 4:00 PM	Afternoon break		
4:00 PM – 5:30 PM	IAQ Monitoring and Field Measurements Results	Capturing Contaminants for Residential Cooking	Healthy Homes: Introducing the Healthy Home Evaluator Credential

Monday, September 12, 8:00 AM-9:00 AM

Opening Session

Welcome Remarks

KEYNOTE 1

On the Quest for Indices Defining Indoor Air Quality: What is a Reasonable Approach?

Room: Presidential Ballroom

Pawel Wargocki, Technical University of Denmark, Kongens Lyngby, Denmark

Different approaches and indices have been used to define indoor air quality. The most frequently used are ventilation rate and concentration of carbon dioxide. Other approaches define the levels of dissatisfaction with indoor air quality or concentration of airborne volatile organic compounds. Yet, the questions remain unanswered as to what the premise should be for defining indoor air quality, which outcome/modality should be used for that purpose, and whether we can agree on a simple metric. The basic human requirements need to be always warranted and full spectrum of pollutants considered. Strategy for attaining indoor air quality index will be proposed.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Voting Session: General questions from attendees

Monday, September 12, 9:15 AM-10:45 AM

CONFERENCE PAPER SESSION 1A

Approaches and Tools for Better IAQ

Room: Kennedy

1. Quality Assurance in Building Ventilation Systems

Marco C. Hofman, ISSO – Dutch Building Services Knowledge Centre, Rotterdam, Netherlands

2. The New Hampshire Mold Task Force Presents “Mold Legislation for NH”

Guy Sylvester, CMC, CIEC, Absolute Resource Associates, Portsmouth, NH

3. Optimizing Indoor Air Quality in Green Buildings

Dhvani Parikh, Ph.D.¹, Larissa Oaks¹ and Sara Cederberg, AIA¹, (1)U.S. Green Building Council, Washington, DC

4. The Evolution of the BCA Green Mark Scheme in Singapore: A Paradigm Shift from an Energy Focused Rating System to an Occupant Centric Criteria with Higher Emphasis on IAQ

Jangyoung Lee¹ and Kwok Wai Tham, Ph.D.², (1)Building and Construction Authority, Singapore, Singapore, (2)National University of Singapore, Singapore, Singapore

5. IAQ Certification Programs: Early Results of the Pivot from Reactive to Proactive

Elliott Horner, Ph.D., Member¹, John Shan, Ph.D.², Dimpy Daroch³ and Tony Worthan, MPH¹, (1)UL Environment, Marietta, GA, (2)UL Environment, Shanghai, China, (3)UL Environment, New Delhi, India

CONFERENCE PAPER SESSION 1B

Characterization of IAQ Performance of Products and Systems 1

Room: Roosevelt

1. Impact of Environmental Tobacco Smoke on Membrane-Based Energy Recovery Ventilators: Water Vapor Transport and Contaminant Crossover

Amin Engarnevis, Student Member¹, Alexander Sylvester, Student Member¹, Ryan Huizing, P.Eng.², Steven Rogak, Ph.D., P.E.¹ and Sheldon Green, Ph.D., P.E.¹, (1)University of British Columbia, Vancouver, BC, Canada, (2)dPoint Technologies, Vancouver, BC, Canada

2. Temperature-Based Ventilation Control

Michael Lubliner, Member¹, Paul W. Francisco, Member², Brennan Less³, Iain Walker, Ph.D., Fellow ASHRAE⁴ and Zachary Merrin, Member², (1)Washington State University Extension Energy Program, Olympia, WA, (2)University of Illinois at Urbana-Champaign, Champaign, IL, (3)Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA, (4)Lawrence Berkeley National Laboratory, Berkeley, CA

3. Know Where Your Air Comes from: Common Problems with High Rise Residential Ventilation

Scott Bondi, Ph.D., P.E., Member¹ and Sean O'Brien, P.E., Member¹, (1)Simpson Gumpertz & Heger, New York, NY

4. Personalized Ventilation - Personalized Exhaust Ventilation Strategy for Reducing the Risk of Airborne Cross Infection in Healthcare Centre Consultation Rooms

Junjing Yang, Ph.D.¹, Chandra Sekhar, Ph.D., Fellow ASHRAE¹, Kok Wai Cheong, Ph.D.¹ and Benny Raphael, Ph.D.², (1)National University of Singapore, Singapore, Singapore, (2)IIT Madras, Chennai, India

STEERING COMMITTEE SESSION 1C

Demand-controlled Ventilation: Assessment Methods and Potential

Room: Presidential Ballroom

Chair: Rémi Carrié, Ph.D., Member, ICEE, Lyon, France

1. Demand-Controlled Ventilation: Managing Its Key Parameters to Challenge IAQ and Energy Aspects

Emmanuel Val¹ and Jean-Luc Savin¹, (1)AERECO, Marne la Vallée, France

2. Smart Ventilation : Theoretical Requirements, Potentials, and Practical Issues

Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

10:45 am – 11:15 am

Morning Break

Monday, September 12, 11:15 AM-12:15 PM

CONFERENCE PAPER SESSION 2A

Climate Change

Room: Presidential Ballroom

1. Climatic Adaptation via Simulation of Building Energy Performance

Stamatis Zoras, Ph.D.¹, Sotiris Veranoudis¹ and Argyro Dimoudi¹, (1)Democritus University of Thrace, Xanthi, Greece

2. Climate Change and Indoor Air Quality in the Pacific Northwest

Max Kirk, Ph.D., Associate Member¹, Brian Lamb¹, Shelley Pressley¹, Tom Jobson¹, Von Walden¹, Diane Cook¹, Madeline Fuchs¹, Patrick O'Keeffe¹, Yibo Huangfu¹, Nathan Lima¹ and Beiyu Lin¹, (1)Washington State University, Pullman, WA

SEMINAR 2B

International Urban IAQ (China & India)

Room: Kennedy

Chair: Paul Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

Indoor Air Quality in many parts of the world is impacted significantly by high population density and outdoor air pollution. This in turn means that strategies, such as ventilation, that may work in North America do not work as well in these locations. This session focuses on two such locations, urban environments in China and India. In both of these locations outdoor particulate matter levels can be more than an order of magnitude higher than in most of North America. This session will discuss the challenges in these locations as well as common solutions and how effective these solutions are.

1. IAQ in Urban India

Richie Mittal, Overdrive Engineering Pvt Ltd, New Delhi, India

2. IAQ in Urban China

Yinping Zhang, Ph.D.¹ and Mengyan Gong², (1)Tsinghua University, Beijing, China, (2)National Institute of Standards and Technology, Gaithersburg, MD

STEERING COMMITTEE SESSION 2C

The Policymaker's Perspective: Exploring How Congress, the Federal Government, and States Strive to Improve IAQ

Room: Roosevelt

Chair: Mark Ames, Associate Member, ASHRAE, Washington, DC

1. The Federal Government's Role in IAQ

Janet McCabe, U.S. Environmental Protection Agency, Washington, DC

2. How States Address IAQ

Cole Stanton, Indoor Air Quality Association, Atlanta, GA

3. Congress' Role in Addressing IAQ

Mark Ames, Associate Member, ASHRAE, Washington, DC

12:30 pm – 1:30 pm

Lunch

Monday, September 12, 1:30 PM-2:00 PM

KEYNOTE 2

From Project to Portfolio: Drivers and Barriers to Scaling up IAQ Performance from 1,000+ Property Companies and Funds around the World

Room: Presidential Ballroom

Chris Pyke, Global Real Estate Sustainability Benchmark, Washington, DC

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Monday, September 12, 2:15 PM-3:30 PM

CONFERENCE PAPER SESSION 3A

Characterization of IAQ Performance of Products and Systems 2

Room: Roosevelt

1. Disinfection Performance of an Ultraviolet Coil Irradiation System in a Hot and Humid Climate

Chandra Sekhar, Ph.D., Fellow ASHRAE¹, Li Ting Soh², Vivien Goh², Hooi Ming Yap², Yi Wang¹, Ramona A Gutiérrez², Lee Ching Ng², Kok Wai Cheong, Ph.D.¹ and William P. Bahnfleth, PhD, P.E., FASHRAE, FASME, Fellow ASHRAE³, (1)National University of Singapore, Singapore, Singapore, (2)Environmental Health Institute, National Environmental Agency, Singapore, Singapore, (3)Pennsylvania State University, State College, PA

2. Study on Air-Conditioning Load Reduction-Effect of the Ventilation System Using Underfloor Space

Yoshihiko Akamine, Ph.D., BEAP¹, Takao Sawachi, Ph.D., BEAP² and Hisashi Miura, Ph.D., BEAP¹, (1)National Institute for Land and Infrastructure Management, Tsukuba, Japan, (2)NILIM, Tsukuba, Japan

SEMINAR 3B

Residential 1

Room: Presidential Ballroom

1. Development of a Nationally Representative Set of Combined Building Energy and Indoor Air Quality Models for U.S. Residences

Torkan Fazli, Student Member¹ and Brent Stephens¹, (1)Illinois Institute of Technology, Chicago, IL

2. Best Practices: Residential PM2.5 Exposure Interventions

Terry Brennan, Member¹ and Brent Stephens², (1)Camroden Associates, Inc., Westmoreland, NY, (2)Illinois Institute of Technology, Chicago, IL

3. ASHRAE Residential IAQ Guide

Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

4. Pilot Study of Range Hood Effectiveness at Reducing Nitrogen Oxides and Particle Number Concentrations from Natural Gas Cooking Burners in Homes

Brett Singer, Ph.D., Member¹, Randy Maddalena, Ph.D.¹, Woody Delp, Ph.D.¹ and David Lorenzetti, Ph.D.¹, (1)Lawrence Berkeley National Laboratory, Berkeley, CA

5. Ventilation in New New Zealand Houses

Inga J. Smith, Ph.D.¹, Stephen McNeil², Timothy W. Bishop¹, Timothy Divett, Ph.D.¹ and Muthasim Fahmy, Ph.D.³, (1)University of Otago, Dunedin, New Zealand, (2)BRANZ, Wellington, New Zealand, (3)Scion, Rotorua, New Zealand

STEERING COMMITTEE SESSION 3C

Where Are We Going with IAQ Metrics?

Room: Kennedy

Chair: Max H. Sherman, Lawrence Berkeley Laboratory, Berkeley, CA

1. Lbl's IAQ Metrics Development

Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

2. To CO2 or Not to CO2

Andrew Persily, Ph.D., Fellow Life Member, NIST, Gaithersburg, MD

3. Role of Particles

Tom Ben-David, Student Member, Drexel University, Philadelphia, PA

4. Semi-Quantitative Methods

Kevin Teichman, Ph.D., Environmental Protection Agency, Washington, DC

3:30 pm – 4:00 pm

Afternoon Break

Monday, September 12, 4:00 PM-5:30 PM

CONFERENCE PAPER SESSION 4A

IAQ Monitoring and Field Measurements Results

Room: Presidential Ballroom

1. Long-Term Monitoring of Indoor Air Quality in a High-Rise Multi-Family Building with Pressurized Corridor Ventilation in Vancouver, BC

James Montgomery, Ph.D.¹, Lorne Ricketts² and Graham Finch, P.Eng., Associate Member¹, (1)RDH Building Science Inc., Vancouver, BC, Canada, (2)RDH Building Engineering Ltd., Vancouver, BC, Canada

2. Attached Garages: IAQ Implications and Solutions

Zachary Merrin, Member, University of Illinois at Urbana-Champaign, Champaign, IL

3. Practical Strategies for Achieving IAQ in Green Buildings and High Performance Buildings

Marwa Zaatari, Ph.D., Member, enVerid Systems, Boston, MA

4. Indoor Air Quality of Schools: A Case Study Approach

Mitesh Kumar, Associate Member, Orison QEHS LLP, Singapore, Singapore

5. In Praise of Performance: Assessing IEQ Performance of a LEED Platinum Buildings Between Prediction and Verification

Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR

STEERING COMMITTEE SESSION 4B

Capturing Contaminants for Residential Cooking

Room: Kennedy

Chair: Wouter Borsboom, TNO, Delft, Netherlands

1. Developing a Test Method for Kitchen Range Hood Capture Efficiency

Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Case History: Visual Feedback Reduces Marital Stress and Allows IAQ Improvement.

Lew Harriman, Fellow ASHRAE, Mason Grant, Portsmouth, NH

3. Exposure on Particulate Matter in Real Cooking Situations, and Can We Reduce It?

Wouter Borsboom, TNO, Delft, Netherlands

4. Capture Efficiency of Range Hoods, an Industrial Perspective

Forest Venmar, Venmar, Drummondville, QC, Canada

STEERING COMMITTEE SESSION 4C

Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy

Room: Roosevelt

Chair: Cole Stanton, Indoor Air Quality Association, Atlanta, GA

1. Indoor Air Quality Association and Ashrae: New Approaches to Government Affairs Advocacy

Jim Scarborough¹ and Cole Stanton², (1)ASHRAE, Washington, DC, (2)Indoor Air Quality Association, Atlanta, GA

Tuesday, September 13

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM– 8:30 AM	Keynote David Rowson		
9:00 AM– 10:30 AM	Evolution and State of the Art of the Residential Ventilation Standard for North America (ASHRAE 62.2)	General IEQ Issues	Characterization of IAQ performance of Products and Systems 3
10:30 AM – 10:45 AM	Morning break		
10:45 AM – 12:00 PM	IEA EBC Annex 68 Project: Indoor Air Quality Design and Control in Low Energy Residential Buildings	Future of IAQ Sensors and Controls	Practical Strategies for Achieving IAQ in High Performance Buildings
12:00 PM -1:00 PM	Lunch		
1:00 PM– 1:30 PM	Keynote David Jacobs		
1:45 PM – 3:00 PM	IAQ Standards Around the World: Where We Are and Where We Want to Be	Residential 2	Infiltration
3:00 PM – 3:30 PM	Afternoon break		
3:30 PM – 5:00 PM	Residential Paper Session	IAQ Metrics	Indoor Air Quality Association and ASHRAE: New Approaches to Government Affairs Advocacy

Tuesday, September 13, 8:00 AM-8:30 AM

KEYNOTE 3

Public Health Priorities for Indoor Air Quality

Room: Presidential Ballroom

David Rowson, US Environmental Protection Agency, Washington, DC

The U.S. EPA's mission is to protect human health and the environment, and poor indoor air quality (IAQ) is a major environmental health risk. This keynote address briefly describes EPA's current legislative and appropriation priorities for IAQ, and presents emerging public health priorities for IAQ including climate change, energy-efficiency measures in buildings, particulate matter as an indoor pollutant of concern, and IAQ metrics.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Tuesday, September 13, 9:00 AM-10:30 AM

CONFERENCE PAPER SESSION 5A

Characterization of IAQ performance of Products and Systems 3

Room: Roosevelt

1. Toward Making Ventilation Decisions Based on Expected Outcomes: A Flexible Multi-Criteria Framework

Adams Rackes, Student Member¹, Tom Ben-David, Student Member¹ and Michael S. Waring, Ph.D., Associate Member¹, (1)Drexel University, Philadelphia, PA

2. Measured Space-Conditioning Energy and Indoor RH in a Mechanically-Ventilated Lab Home with Fixed and Variable-Capacity Cooling Systems Located in a Hot and Humid Climate

Charles Withers Jr., Florida Solar Energy Center, Cocoa, FL

3. Modeling Monetization of Collateral IAQ Improvements from UVGI for Coil Cleaning

Joseph Firrantello, P.E., Member¹ and William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE¹, (1)Pennsylvania State University, University Park, PA

4. Data Driven Persistent Monitoring of Indoor Air Systems

Sambuddha Ghosal¹, Chao Liu, Ph.D.¹, Ulrike Passe, AIA, Associate Member¹, Shan He¹ and Soumik Sarkar, Ph.D.¹, (1)Iowa State University, Ames, IA

CONFERENCE PAPER SESSION 5B

General IEQ Issues

Room: Kennedy

1. An International Project on Indoor Air Quality Design and Control in Low Energy Residential Buildings

Carsten Rode, Ph.D., Member¹, Marc Ábadie², Menghao Qin³, John Grunewald⁴, Jakub Kolarik, Ph.D.¹, Jelle Laverge⁵ and Jianshun Zhang, Ph.D., Fellow ASHRAE⁶, (1)Technical University of Denmark, Kgs. Lyngby, Denmark, (2)Université de La Rochelle, La Rochelle, France, (3)Nanjing University, Nanjing, China, (4)Technical University of Dresden, Dresden, Germany, (5)Ghent University, Gent, Belgium, (6)Syracuse University, Syracuse, NY

2. Benefits of Intelligent Computational Methods for Big Data Analysis on Indoor Environmental Quality Research

Mika Raatikainen, University of Eastern Finland, Kuopio, Finland

3. Optimising the Scheduled Operation of Window Opening and Blind to Enhance Indoor Air Quality and Visual Comfort

Muhammad Ahmad, Ph.D.¹, Jean-Laurent Hippolyte, Ph.D.¹, Monjur Mourshed, Ph.D.¹, Yacine Rezgui, Ph.D.¹ and Jonathan Reynolds², (1)School of Engineering, Cardiff University, Cardiff, United Kingdom of Great Britain and Northern Ireland, (2)School of Engineering, Cardiff University, Cardiff, United Kingdom

4. Do the Students in High Performance Incentive (HPI) Schools Demonstrate More Academic Improvement Than Their Peers in Non-HPI Schools?

Josephine Lau, Ph.D., Member¹, Shihan Deng, Student Member¹, Houston Lester¹, James Bovaird, Ph.D.¹, Lily Wang, Ph.D., P.E.¹ and Clarence Waters, Ph.D.¹, (1)University of Nebraska - Lincoln, Lincoln, NE

STEERING COMMITTEE SESSION 5C

Evolution and State of the Art of the Residential Ventilation Standard for North America (ASHRAE 62.2)

Room: Presidential Ballroom

Chair: Paul W. Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

1. Where Ashrae 62.2 Is Going - the Long View

Eric Werling, Member, U.S. Department of Energy, Washington, DC

2. Current Topics for Ashrae 62.2

Paul W. Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

3. Where Ashrae 62.2 Has Been

Steven J. Emmerich, Member, National Institute of Standards and Technology, Gaithersburg, MD

4. Ashrae 62.2 and the State of the Science

Brett Singer, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

5. Using ASHRAE 62.2 in New Homes

Elliot Seibert, Steven Winter Associates, Washington, DC

10:30 AM-10:45 AM

Morning Break

Tuesday, September 13, 10:45 AM-12:00 PM

CONFERENCE PAPER SESSION 6A

Natural Ventilation

Room: Kennedy

1. Predicted Ventilation Rate and Thermal Comfort in a Naturally Ventilated Gymnasium in the Northeastern United States

Zheng Cheng, Student Member¹, William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE² and Lingling Li¹, (1)Harbin Institute of Technology, Harbin, China, (2)Pennsylvania State University, University Park, PA

2. How Much Will Factors Influencing on Natural Ventilation Affect the Ventilation Rates and Energy in Office Buildings?

Yan Li, HBDP, Student Member¹ and Xiaofeng Li¹, (1)Department of Building Science, School of Architecture, Tsinghua University, Beijing, China

3. A Probabilistic Representation of Wind Data for Natural Ventilation Estimation

James Lo, Ph.D., Member, Drexel University, Philadelphia, PA

4. A Study on Airing Through the Porches of a Historical Church – Measurements and IDA-ICE Modelling

Abolfazl Hayati, Ph.D.¹, Magnus Mattsson, Dr.Ing.² and Mats Sandberg, Dr.Ing.³, (1)University of Gävle, Gävle, Sweden, (2)University of Gävle, SE-801 76 GÄ., VLE, Sweden, (3)Indoor Environment, University of Gävle, Gävle, Sweden, Gävle, Sweden

STEERING COMMITTEE SESSION 6B

IEA EBC Annex 68 Project: Indoor Air Quality Design and Control in Low Energy Residential Buildings

Room: Presidential Ballroom

Chair: Carsten Rode, Ph.D., Member, Technical University of Denmark, Kgs. Lyngby, Denmark

1. Evaluating the Indoor Air Quality of Low-Energy Residential Buildings

Marc Abadie, Ph.D., Université de La Rochelle, La Rochelle, France

2. The Combined Effects of Temperature and Humidity on Initial Emittable Formaldehyde Concentration of Fiberboard

Menghao Qin, Nanjing University, Nanjing, China

3. Predicting IAQ in Low Energy Houses: The Role of Standard Testing and Benchmarking

Jianshun Zhang, Ph.D., Fellow ASHRAE, Syracuse University, Syracuse, NY

4. Design for “High Indoor Air Quality” in Residences – Current Status and Outlook for the Future

Jakub Kolarik, Ph.D., Technical University of Denmark, Kgs. Lyngby, Denmark

5. Field Measurements and Case Studies

Jelle Laverge, Ghent University, Gent, Belgium

STEERING COMMITTEE SESSION 6C

Practical Strategies for Achieving IAQ in High Performance Buildings

Room: Roosevelt

1. Occupants' Satisfaction, Acute Health Symptoms and Performance in Certified Office Buildings

Pawel Wargocki, Technical University of Denmark, Kongens Lyngby, Denmark

2. Practical Strategies for Achieving IAQ in Green Buildings and High Performance Buildings

Marwa Zaatari, Ph.D., Member, enVerid Systems, Boston, MA

3. Optimizing Indoor Air Quality in Green Buildings

Sara Cederberg, AIA, U.S. Green Building Council, Washington, DC

4. Operational Indoor Air Quality Monitoring and Management Protocols Across Google's Global Portfolio

Lauren Riggs¹ and Ed Baylous¹, (1)Google, Inc, Mountain View, CA

12:00 pm – 1:00 pm
Lunch

Tuesday, September 13, 1:00 PM-1:30 PM

KEYNOTE 4

Bending the Healthcare Cost Curve: Indoor Air Quality and Healthy Housing

Room: Presidential Ballroom

David Jacobs, Ph.D., Member, National Center for Healthy Housing, Washington, DC

This presentation will examine how good indoor environmental quality and quality housing can support health, potentially reduce health care costs, and why this connection is essential for economic and human development. Key gaps in knowledge as well as disconnects in housing investment and health care policies remain, and are pronounced in respiratory health and ventilation system design. A World Health Organization project to produce new international healthy housing guidelines, as well as recently completed studies will be reviewed. In particular, a recently published study comparing new and older ASHRAE residential ventilation standards during weatherization showed that improved ventilation rates, moisture balance, and indoor air quality yielded significant health improvements for children, who had fewer headaches, eczema and skin allergies and also for adults who had improvements in psychological distress. These findings have profound implications for both ventilation policy and health policy. Creation of new dynamic links between ventilation engineers and housing and health professionals is needed to improve the evidence base.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Tuesday, September 13, 1:45 PM-3:00 PM

CONFERENCE PAPER SESSION 7A

Infiltration

Room: Roosevelt

1. Development of a Numerical Air Infiltration Model Based On Pressurization Test Applied On a Church

Abolfazl Hayati, Ph.D.¹, Jan Akander, Dr.Eng.¹ and Magnus Mattsson, Dr.Eng.², (1)University of Gävle, Gävle, Sweden, (2)University of Gävle, SE-801 76 GÄ., VLE, Sweden

2. Experimental Study of Multizone Air Leakages in Low Energy Houses

Gaëlle Guyot, Ph.D., Member¹, Jérémy Ferlay, P.Eng.¹, Thibaud Bello, P.Eng.¹, Evelyne Gonze, Ph.D., P.E.² and Monika Woloszyn, Ph.D., P.E.², (1)Cerema DTer CE, Isle d'Abeau, France, (2)Savoie Mont-Blanc University, Le Bourget du Lac, France

3. Analyses of about 90 000 Airtightness Measurements Performed in France on Residential and Non-Residential Buildings from 2008 to 2014

Adeline Bailly¹, Gaëlle Guyot, Ph.D., Member² and Valérie Leprince, Ph.D.³, (1)Cerema DTer CE, Isle d'abeau, France, (2)Cerema DTer CE, Isle d'Abeau, France, (3)PLEIAQ, Meyzieu, France

4. On the Origin of Leakage-Infiltration Ratios Previously Hidden By Means of Natural Obfuscation

Benjamin Jones¹, Max H. Sherman² and Andrew Persily, Ph.D., Member³, (1)University of Nottingham, Nottingham, United Kingdom of Great Britain and Northern Ireland, (2)Lawrence Berkeley Laboratory, Berkeley, CA, (3)National Institute of Standards and Technology, Gaithersburg, MD

SEMINAR 7B

Residential 2

Room: Kennedy

1. Healthy Efficient New Gas Homes (HENGH) – Survey and Pilot Test Results

Max H. Sherman¹, Wanyu Chan, Ph.D.², Brett Singer, Ph.D., Member² and Iain Walker, Ph.D., Fellow ASHRAE², (1)Lawrence Berkeley Laboratory, Berkeley, CA, (2)Lawrence Berkeley National Laboratory, Berkeley, CA

2. Ventilation Retrofits for Energy Savings in High Rise Multi-Family Buildings

Davidge Warfield, OPMP, Member, ASHRAE and IAQA, Wilmington, DE

3. Population Impact Assessment Modeling Framework (PIAMF): Evaluating the Effects of Infiltration, Ventilation, and Filtration, on PM2.5 Exposure in US Housing Stock

Brett Singer, Ph.D., Member¹, Wanyu Chan, Ph.D.¹, Jennifer Logue, Ph.D.¹, Neil Klepeis, Ph.D.² and Max H. Sherman³, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Center for Behavioral Epidemiology and Community Health, San Deigo, CA, (3)Lawrence Berkeley Laboratory, Berkeley, CA

4. Measurement-Based Evaluation of Ventilation, Filtration, and Air Cleaning Systems in a Modern California Detached House

Brett Singer, Ph.D., Member¹, Douglas Black, Ph.D.¹, Hugo Destailats, Ph.D.², Woody Delp, Ph.D.¹ and Iain Walker, Ph.D., Fellow ASHRAE¹, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkeley National Laboratory, Berkeley, CA, USA, Berkeley, CA

STEERING COMMITTEE SESSION 7C

IAQ Standards Around the World: Where We Are and Where We Want to Be

Room: Presidential Ballroom

Chair: Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

1. ASHRAE Ventilation and IAQ Standards: a Short History

Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Cen and ISO Ventilation and IAQ Standards

Bjarne W. Olesen, Ph.D., Fellow ASHRAE, Technical University of Denmark, Kongens Lyngby, Denmark

3. Review of Asian IAQ Standards

Chandra Sekhar, Ph.D., Fellow ASHRAE, National University of Singapore, Singapore, Singapore

4. AIVC Activities in Relation to Standards, Regulations and Implementation in Practice

Peter Wouters, Ph.D., Member, Belgian Building Research Institute, Brussels, Belgium

5. U.S. Environmental Protection Agency IAQ Guidance

Laura Kolb, US Environmental Protection Agency, Washington, DC

6. IAQ Standards of the Future: Recent Research on the Connections Between Ventilation and Health

3:00 pm – 3:30 pm
Afternoon Break

Tuesday, September 13, 3:30 PM-5:00 PM

CONFERENCE PAPER SESSION 8A

IAQ Metrics

Room: Kennedy

1. Indoor Exposure to Particulate Matter - the State of the Science

David Butler, Ph.D.¹ and Guru Madhavan, Ph.D.¹, (1)National Academies of Sciences, Engineering, and Medicine, Washington, DC

2. Empirical Predictive Modeling of the Impact of Ventilation and Filtration on Energy Cost and Monetized IAQ Exposure in Offices in the U.S

Tom Ben-David, Student Member¹ and Michael S. Waring, Ph.D., Associate Member¹, (1)Drexel University, Philadelphia, PA

3. Characterizing Indoor Air Quality Performance Using a Graphical Approach

Kevin Teichman, Ph.D.¹, Andrew Persily, Ph.D., Member² and Steven Emmerich, Member², (1)Environmental Protection Agency, Washington, DC, (2)National Institute of Standards and Technology, Gaithersburg, MD

4. Allergen Exposures and the Quest for a Healthier Home

Eva M King, Ph.D., Ph.D., Member IAQA, Indoor Biotechnologies Inc, Charlottesville, VA

CONFERENCE PAPER SESSION 8B

Residential Paper Session

Room: Presidential Ballroom

1. Carbon Monoxide Measurements in Homes

Paul W. Francisco, Member¹, Scott Pigg, Member², Dan Cautley, Member², William B. Rose, Fellow ASHRAE¹, David Jacobs, Ph.D., Member³ and Salvatore Cali⁴, (1)University of Illinois at Urbana-Champaign, Champaign, IL, (2)Seventhwave, Madison, WI, (3)National Center for Healthy Housing, Washington, DC, (4)University of Illinois at Chicago, Chicago, IL

2. Developing a Capture Efficiency Test Method for Residential Range Hoods

Iain Walker, Ph.D., Fellow ASHRAE¹, Max H. Sherman², Brett Singer, Ph.D., Member¹, Woody Delp, Ph.D.¹ and Chris Stratton¹, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkeley Laboratory, Berkeley, CA

3. PM2.5 in Dutch Dwellings and the Effect of Mitigation Actions

Piet Jacobs¹, Wouter Borsboom¹ and Richard Kemp¹, (1)TNO, Delft, Netherlands

4. Are Residential Whole House Mechanical Ventilation Systems Reliable Enough to Mandate Tight Homes?

Jeffrey K. Sonne¹, Charles R. Withers¹ and Robin K. Vieira¹, (1)Florida Solar Energy Center, Cocoa, FL

5. The Latest Developments in Residential Combustion Safety Testing

Paul W. Francisco, Member¹, **Larry Brand, Member²**, **Dan Cautley, Member³**, **Brett Singer, Ph.D., Member⁴** and **Stacy Gloss¹**,
(1)University of Illinois at Urbana-Champaign, Champaign, IL, (2)Gas Technology Institute, Davis, CA, (3)Seventhwave,
Madison, WI, (4)Lawrence Berkeley National Laboratory, Berkeley, CA

6. How the Building America IAQ Roadmap Will Help Define IAQ for High Performance Homes

Eric Werling, Member¹ and **Iain Walker, Ph.D., Fellow ASHRAE²**, (1)U.S. Department of Energy, Washington, DC,
(2)Lawrence Berkeley National Laboratory, Berkeley, CA

STEERING COMMITTEE SESSION 8C

Healthy Homes: Introducing the Healthy Home Evaluator Credential

Room: Roosevelt

Chair: Larry Zarker, Member, Building Performance Institute, Inc, Malta, NY

1. Healthy Homes: Introducing the Healthy Home Evaluator Credential

Kevin Kennedy, Member IAQA, Children's Mercy Hospital and Clinics, Kansas City, MO

2. Healthy Homes: Introducing the Healthy Home Evaluator Micro-Credential

Ruth Ann Norton, Green & Healthy Homes Initiative, Baltimore, MD

3. Healthy Homes: Introducing the Healthy Home Evaluator Credential

John Davies, Building Performance Center, Bellingham, WA

Wednesday, September 14

	Presidential Ballroom	Kennedy	Roosevelt
8:00 AM– 8:30 AM	Keynote Howard Wolf		
8:45 AM– 10:30 AM	Indoor Environmental Quality and Health	Ventilation and IAQ Measurement Methods	High Performance Buildings and Applications
10:30 AM – 11:00 AM	Morning break		
11:00 AM – 12:30 PM	Natural ventilation	Modeling Air Movement and Pollutant Transport	Continuous Assessment of Indoor Environmental Quality using an Innovative Pre-/Post-Occupancy Evaluation Protocol for High Performance Buildings
12:30PM -1:15 PM	Closing Remarks		

Wednesday, September 14, 8:00 AM-8:30 AM

KEYNOTE 5

Reviving the “Lost Step” in IH Remediation Protocols and Remediation Plans

Room: Presidential Ballroom

Howard E. Wolf, HW3 Group, LLC/Standards Chairman - IICRC, Richfield, WI

For years, the restoration, cleaning and remediation industries have moved towards reliance on improvements in equipment and chemical technology to perform their services. This has caused the focus on source removal to be blurred. The revised ANSI/IICRC standards attempt to return the focus to traditional source removal, including mechanical cleaning processes. Mr. Wolf will discuss the position of the revised S500 Water Damage Restoration and S520 Mold Remediation standards on mechanical processes and chemical technology to reduce airborne contaminant load; thereby, reducing the reliance on air filtration devices and other control measures. It has become a “lost step” in many protocols and remediation plans.

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

Wednesday, September 14, 8:45 AM-10:30 AM

CONFERENCE PAPER SESSION 9A

Ventilation and IAQ Measurement Methods

Room: Kennedy

1. Reliability of Ventilation System Inspection for Dwellings: Comparisons of Measurements and Controls Protocols Tested during in-Situ Campaigns of the Promevent Project

Adeline Bailly¹ and Sylvain Berthault, P.Eng.², (1)Cerema DTer CE, Isle d'abeau, France, (2)Cerema DTer CE, Autun, France

2. Testing a Powered Flow Hood on a Variety of Registers

Niek-Jan Bink, Ph.D., ACIN instrumenten, Rijswijk, Netherlands

3. A New Method for Indoor Air Measurement

Clifford Cooper¹ and Kathleen Cooper¹, (1)The VERTEX Companies Inc., Air Quality Services, Kingston, NY

4. Spatial Resolution and Sensor Accuracy in Networks for Routine Indoor Air Quality Monitoring: Are More Sensors Better?

Adams Rackes, Student Member¹ and Michael S. Waring, Ph.D., Associate Member¹, (1)Drexel University, Philadelphia, PA

5. Airtightness of Buildings – Considerations Regarding the Zero-Flow Pressure and the Least Square Regression

Peter Wouters, Ph.D., Member¹ and Christophe Y. Delmotte², (1)Belgian Building Research Institute, Brussels, Belgium, (2)Belgian Building Research Institute, Limelette, Belgium

6. In-Situ, Real-Time and High Performance Optical Analyzer for Low Cost Indoor Air Quality Diagnoses

Julie Delahaye, Ph.D.¹, Cyrille Levy, FREng¹, H  l  ne Bu  e, FREng¹ and Johann Georges des Aulnois, FREng², (1)Engie, Saint-Denis, France, (2)Blue Industry and Science, Saint-Denis, ME, France

7. Performance Validation of Low-Cost Air Quality Sensors

Amanda Green, Student Member¹, Donghyun Rim, Ph.D., Associate Member¹ and Brandon E. Boor, Ph.D., Associate Member², (1)Pennsylvania State University, University Park, PA, (2)Purdue University, West Lafayette, IN

SEMINAR 9B

High Performance Buildings and Applications

Room: Roosevelt

1. Ventilation Rehabilitation in Existing Buildings. Innovations Spark New Trend in NYC Building Retrofitting.

Neal Walsh, Aeroseal LLC, Centerville, OH

2. Remote Real Time Cloud Based Monitoring - a Healthcare Construction Case Study Narrative

Bruce White, Affiliate¹ and Vasileios Nasis, Ph.D.², (1)American Environmental Specialists, Huntington Beach, CA, (2)Netronix, Inc., Philadelphia, CA

3. Indoor Air Quality Investigation of a Deployable US Army Low-Energy, High-Performance Building

Lauren Koban¹, Darius Javan¹ and Philip Dacunto, P.E.¹, (1)United States Military Academy, West Point, NY

4. IAQ in Standard 189.1: Is It Really High Performance?

Andrew Persily, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

5. Application of Low-Cost Particle Sensors for Monitoring of Indoor Air Quality (IAQ) in Buildings

Mir Seliman Waez, Student Member¹, Steven Eckels, Ph.D., Member¹ and Christopher Sorensen, Ph.D.¹, (1)Kansas State University, Manhattan, KS

6. Improving IAQ with an Innovative New Photo-Electrochemical Technology and Reducing Energy Consumption in Buildings

Dilip Goswami, Transformair, San Francisco, CA

SEMINAR 9C

Indoor Environmental Quality and Health

Room: Presidential Ballroom

1. Wood Floorings Emissions and Their Effect on Indoor Air Quality

Marco Fellin, Ph.D.¹ and Martino Negri, Ph.D.¹, (1)CNR-IVALSA, San Michele all'Adige, Italy

2. Managing Legionella and Dangerous Outbreaks with Preventative Maintenance

Ray Field, CEng, Goodway Technologies, Stamford, CT

3. Classification of Building Dampness

Ed Light, Member¹ and Veronica Stanley¹, (1)Building Dynamics, LLC, Ashton, MD

4. Critical Review of ASHRAE Standards Addressing VOC Mixtures

Ed Light, Member¹ and Veronica Stanley¹, (1)Building Dynamics, LLC, Ashton, MD

5. Summary of Recent National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluations (HHEs) in Schools

Nancy Clark Burton, Ph.D., Member¹, Elena Page, M.D.¹ and John Gibbins¹, (1)CDC/NIOSH, Cincinnati, OH

10:30 am – 11:00 am

Morning Break

Wednesday, September 14, 11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 10A

Modeling Air Movement and Pollutant Transport

Room: Kennedy

1. Evaluating IAQ and Energy Impacts of Ventilation in a Net-Zero Energy House Using a Coupled Model

Lisa Ng, Ph.D., Member¹, Stuart Dols, Member¹, Dustin Poppendieck, Ph.D.¹ and Steven Emmerich, Member¹, (1)National Institute of Standards and Technology, Gaithersburg, MD

2. A Computational Evaluation of the Impacts of Radon Concentrations in Energy Retrofit Buildings in Ireland

James McGrath, Ph.D., National University of Ireland, Galway, Galway, Ireland

3. Passenger Vehicle Ventilation and Secondhand Smoke Particulate Measurements

David Bohac, P.E., Member¹, Emily Waldhart¹ and Zheng Zhou, Ph.D.¹, (1)Center For Energy & Environment, Minneapolis, MN

4. The Study of Human Feelings about Cabin Air Quality

Susu Jia¹, Junjie Liu, Ph.D., Member¹ and Jian Kang¹, (1)Tianjin University, Tianjin, China

5. Comparing Between CFD Simulation and Experimental Results of Wind Speed Conditions in Passages Between Residential Buildings

Junjie Liu, Ph.D., Member¹ and Fenghua Fan¹, (1)Tianjin University, Tianjin, China

STEERING COMMITTEE SESSION 10B

Continuous Assessment of Indoor Environmental Quality using an Innovative Pre-/Post-Occupancy Evaluation Protocol for High Performance Buildings

Room: Roosevelt

Chair: Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR Todd DiNoia, Ph.D., Saint-Gobain Northboro Research and Development Center, Northboro, MA

1. Closing the Building Design-Operation Loop: Innovative Spatial IEQ Assessment Methods and Applications

Ihab Elzeyadi, Ph.D., HBDP, Member, University of Oregon, Eugene, OR

2. Collaborative IEQ Assessments for an Office Park Campus

Stanley Gatland II, Member, Saint Gobain Corporation, Philadelphia, PA

STEERING COMMITTEE SESSION 10C

Future of IAQ Sensors and Controls

Room: Presidential Ballroom

Chair: Eric Werling, Member, U.S. Department of Energy, Washington, DC

1. Future of IAQ Sensors and Controls

Gordon Sharp, Member, Aircuity Inc, Newton, MA

2. Future of IAQ Sensors and Controls

Brett Singer, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

3. Future of IAQ Sensors and Controls

Charlene Bayer, Ph.D., Member, Hygieia Sciences LLC, Atlanta, GA

Wednesday, September 14, 12:00 PM-1:15 PM

CLOSING SESSION

Closing Remarks

Voting Session

Invitation to Future Conferences

Adjournment