

# IEQ 2025 Conference

September 24th - September 26th, 2025

Wednesday, September 24

Wednesday, September 24, 9:30 AM - 10:30 AM

## Paper Session 1

### Psychology and Physiology of the Indoor Environment

Room: Opus Ballroom

Chair:

#### 1. Psychology of Indoor Environmental Quality

*Brent Altomose, AltIH LLC, Neptune, NJ*

#### 2. (Dis)comfort and Health-Induced Stress: the Need for Unravelling their Effects

*Philomena M. Bluyssen, Delft University of technology, Delft, Netherlands*

#### 3. Why Thermal Comfort Is Elusive – The Role of Socio-Cultural Factors

*Marcel Harmon and Stuart Shell, BranchPattern, Kansas City, AR*

9:30 AM - 10:30 AM

## Paper Session 2

### ASHRAE 241: Application Case Studies, The Role of the Public Health Community

Room: Concerto

Chair:

#### 1. Preliminary Results of Piloting ASHRAE Standard 241 in the Federal Building Stock

*Kevin Keene, Full Member<sup>1</sup>, Jinzhao Tian<sup>2</sup>, Haipei Bie<sup>2</sup>, Vivian Lofness<sup>2</sup> and Brian Gilligan<sup>3</sup>, (1)Pacific Northwest National Laboratory, Washington, DC, (2)Carnegie Mellon University, Pittsburgh, PA, (3)U.S. General Services Administration, Washington, DC*

#### 2. Case Studies of Deploying ASHRAE Standard 241 in Office Buildings

*Mengjia Tang, Full Member, Jason DeGraw and Yanfei Li, Ph.D., Associate, Oak Ridge National Laboratory, Knoxville, TN*

#### 3. The Future of ASHRAE Standard 241: The Role of the Public Health Community

*Georgia Lagoudas, Brown University, Washington, DC*

9:30 AM - 10:30 AM

## Paper Session 3

### Airtightness Applications, Repeatability, and Lessons Learned

Room: Ravel

Chair:

#### 1. Application Of A Tool To Estimate The Level Of Airtightness Of Residential Buildings

*Irene Poza-Casado, Miguel Fernández-Temprano, Pilar Rodríguez-del-Tío and Alberto Meiss, Universidad de Valladolid, Valladolid, Spain*

#### 2. How Precise is Airtightness Testing? Exploring Repeatability, Reproducibility, and Uncertainty Quantification

*Martin Prignon<sup>1</sup>, Ben Roberts<sup>2</sup>, Liesje Van Gelder<sup>3</sup>, Maarten De Strycker<sup>3</sup> and Jiri Novak<sup>4</sup>, (1)Buildwise, Zaventem, Belgium, (2)Loughborough University, Loughborough, United Kingdom, (3)BCCA, Diegem, Belgium, (4)CTU Prague, Prague, Czech Republic*

#### 3. Lessons Learned from Airtightness Testing

*Yash Pareshkumar Vyas<sup>1</sup>, Justin David Berquist, PhD (c), PEng, Associate<sup>2</sup>, Russell Richman<sup>1</sup> and Michal Bartko<sup>2</sup>, (1)Toronto Metropolitan University, Scarborough, ON, Canada, (2)National Research Council Canada, Ottawa, ON, Canada*

9:30 AM - 10:30 AM

#### Paper Session 4

### Data Usability, Experimental Investigation, and Generative AI Forecasting

Room: Tchaikovsky

Chair:

**1. Assessing Building Automation System Data Usability for Indoor Environmental Quality Monitoring: A Comparative Study with Low-Cost Sensors in University Lecture Halls**

*Serra Yildirim and Marianne Touchie, PhD, Member, University of Toronto, Toronto, ON, Canada*

**2. Experimental Investigation Of The Indoor Air Quality Of A UK Home**

*Leonid Suevalov and Xiaofeng Zheng, University of Nottingham, Nottingham, United Kingdom*

Wednesday, September 24, 11:00 AM - 12:30 PM

#### Paper Session 5

### Ventilation Design Strategies

Room: Ravel

Chair:

**1. Using Natural Language Processing for Designing Air Distribution in an Indoor Space**

*Ting Dai<sup>1</sup> and Qingyan Chen<sup>2</sup>, (1)The Hong Kong Polytechnic University, Kowloon, Hong Kong, (2)Harvard University, Cambridge, MA*

**2. A Bio-Inspired Ventilation Approach for Enhancing Indoor Air Quality in Underground Shelters**

*Hamada Shaaban Abdelkader Mostafa<sup>1</sup>, Darya Abramkina<sup>2</sup> and Yingzi Zhang<sup>3</sup>, (1)Southwest Jiaotong University, Chengdu, China, (2)Aswan University, Aswan, Egypt, (3)Moscow State University of Civil Engineering, Moscow, Russia*

**3. Optimizing Ventilation System Sizing with Occupancy Diversity: Balancing Energy Efficiency and Indoor Air Quality**

*Narges Torabi, P.Eng, Associate<sup>1</sup> and Majid Kafimousavi<sup>2</sup>, (1)PSPC, Ottawa, ON, Canada, (2)Gastops, Ottawa, ON, Canada*

**4. Optimizing Ventilation: A Comprehensive Approach to Lower Carbon Footprint and Better Indoor Environmental Quality**

*Aaditya Ajaykumar Patel, Associate and Dhrumil Umeshbhai Khatri, Eng, Associate, Stantec Consulting Ltd., Ottawa, ON, Canada*

**5. Impact of Ventilation Configurations on Airborne Pathogen Dispersion in Hospital Corridors: A Numerical Investigation**

*Zeinab Deldoost Fattahi<sup>1</sup>, Fariborz Haghghat<sup>2</sup> and Fuzhan Nasiri, Professor & Associate Chair, Building, Civil, and Environmental Engineering<sup>1</sup>, (1)Concordia University, Montreal, QC, Canada, (2)Concordia University, Montréal, QC, Canada*

11:00 AM - 12:30 PM

#### Paper Session 6

### IEQ, Lighting and Occupant Preference

Room: Tchaikovsky

Chair:

**1. Data-efficient Personal Thermal Comfort Estimation Using Meta-learning and Bayesian Inference**

*Hejia Zhang<sup>1</sup>, Seungjae Lee, Ph.D., Associate<sup>2</sup> and Athanasios Tzempelikos, PhD, Full Member<sup>1</sup>, (1)Purdue University, West Lafayette, IN, (2)University of Toronto, Toronto, ON, Canada*

**2. Learning Daylighting Preferences Using Non-intrusive Image Sensing and Deep Learning Techniques**

*Sichen Lu, Student, Dongjun Mah, Student and Athanasios Tzempelikos, PhD, Full Member, Purdue University, West Lafayette, IN*

**3. Utilization of Passive Solar Energy in the Arctic: Glazed Balcony Coupled with Room Ventilation Unit**

*Liguo Chen and Bjoern REIDAR Soerensen, The Arctic University Of Norway, Narvik, Norway*

**4. Development of GUI Image-Based Daylight Simulation Module for Human-Centered Daylighting**

*Kyungmin Kang<sup>1</sup>, Michael Y Kim, Associate<sup>1</sup> and Andreas K Athienitis<sup>2</sup>, (1)Chung-Ang University, Seoul, South Korea, (2)Concordia University, Montreal, QC, Canada*

**5. Comparison And Optimization Of Mean Skin Temperature Assessment At Dynamic Boundary Conditions**

*Kai Rewitz, Dr.-Ing., Simon Rösel and Dirk Müller, RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate, Aachen, Germany*

11:00 AM - 12:30 PM

### Workshop 1 (Intermediate)

## Indigenous Perspectives And Community-Led Approaches To Shaping Indoor Environments

Room: Opus Ballroom

Chair: Sarah Haines, PhD, Member, University of Toronto, Toronto, Canada

Many First Nations communities across Canada continue to face critical housing challenges, including poor indoor environmental quality (IEQ), overcrowding, and homes in urgent need of repair. These conditions are not only structural but deeply tied to systemic inequities and colonial legacies. Addressing these challenges requires approaches that center Indigenous perspectives, lived experiences, and self-determined priorities. This session will explore community-led strategies for improving IEQ through a Two-Eyed Seeing framework, bringing together Indigenous and Western ways of knowing to co-develop meaningful, sustainable solutions. Through hands-on activities and presentations from Indigenous leaders and housing practitioners, participants will gain insight into the cultural, technical, and environmental dimensions of indoor environments in First Nations communities. Drawing from our 'From Harvest to House' program, we will highlight how storytelling, knowledge sharing, and capacity building are used to empower community champions and drive local innovation. By grounding our work in relationships and respect, we aim to shift how engineered solutions are conceived and implemented, ensuring they are not only technically sound, but also culturally resonant and community-driven.

### 1. Workshop Introduction

Sarah Haines, PhD, Member, University of Toronto, Toronto, ON, Canada

### 2. Two-Eyed Seeing And IEQ Challenges On-Reserves

Natalie Clyke, From Harvest to House, Toronto, ON, Canada

### 3. From Harvest to House: Centering community engagement and community led-approaches to housing

Helen Stopps, Toronto Metropolitan University, Toronto, ON, Canada

### 4. Redefining Our Relationship To Building Materials Through Two-Eyed Seeing

Becky Canoe, Mno Aki Land Trust, Toronto, ON, Canada

11:00 AM - 12:30 PM

### Workshop 2 (Intermediate)

## IEA-EBC Annex 78 Supplementing Ventilation With Gas-phase Air Cleaning, Implementation And Energy Implications

Room: Concerto

Chair: Bjarne Olesen, ICIEE, DTU.SUSTAIN, Denmark, Copenhagen, Denmark

There are an increasing number of publications in many countries related to air cleaning and increasing sales of gas-phase air cleaning products. This introduces a demand for verifying the efficacy of air cleaning on indoor air quality for comfort, well-being, and health. It is thus important to learn whether air cleaning can supplement ventilation by improving air quality, i.e. whether it can partly substitute the ventilation rates required by standards. Also, the energy impact of using air cleaning as a supplement to ventilation needs to be estimated. This has been topics, which researchers from several countries have looked at in Annex 78 during the period 2018-2025. The session will present of the results of Annex 78. Several studies on energy performance and impact on indoor air quality of gas-phase air cleaning technologies were conducted during the annex. This has resulted in several papers, seminars and reports. Finally a test method is proposed for testing the Clean Air Delivery Rate (CADR) using perceived air quality as a measure.

### 1. Introduction And Major Achievements Of Annex 78

Bjarne Olesen, ICIEE, DTU.SUSTAIN, Denmark, Copenhagen, Denmark

### 2. Gas Phase Air Cleaning Technologies And Related Models

Jianshun Zhang, University of Syracuse, USA, Syracuse, NY

### 3. Energy Performance Of Gas-Phase Air Cleaning Technologies

Alireza Afshari, AAU, BUILD, Copenhagen, Denmark

### 4. A Test Method For Air Cleaning Technologies That includes Perceived Air Quality As A Measure Of Performance

Pawel Wargocki, ICIEE, DTU.SUSTAIN, Copenhagen, Denmark

Wednesday, September 24, 2:00 PM - 3:30 PM

Poster Session 1

Poster Session 1

Room: Tchaikovsky

Chair:

**1. Analysis of IAQ for Two Types of Residential HVAC Systems Located in a Cold Climate**

*Jaya Mukhopadhyay, Montana State University, Bozeman, MT*

**2. Demand-Controlled Ventilation and Smart Home Systems in Energy Calculation Methods for Multifamily Apartment Buildings**

*Kätriin Onemar, Helina Niit, Raimo Simson and Jarek Kurnitski, Tallinn University of Technology, Tallinn, Estonia*

**3. Comprehensive Analysis of Indoor Air Quality in a Real Home using Low-Cost Sensors**

*Marc Abadie, PhD<sup>1</sup> and Kátia Cordeiro Mendonça<sup>2</sup>, (1)La Rochelle University, La Rochelle, France, (2)TIPEE Plateforme Technologique du Bâtiment Durable, Lagord, France*

**4. Evolving Residential Landscapes: Implications from the Update to the Collections of Dwelling for Policy and Standards**

*Nathan Michael Lima<sup>1</sup>, Steven J. Emmerich<sup>2</sup> and Andrew K. Persily<sup>1</sup>, (1)The National Institute of Standards and Technology, Falling Waters, WV, (2)The National Institute of Standards and Technology, Gaithersburg, MD*

**5. Thermal Comfort Analysis Using CFD in Buildings with Lateral Air-Conditioning and HVAC-Integrated Building Envelopes**

*Donghyun Kim and Taeyeon Kim, Yonsei University, Seoul, South Korea*

**6. Method Validation of Experimental Particle Measurements and Exposure Risk in Long-term Health Care Facilities**

*Anneloes de Lange<sup>1</sup>, Karin Kompatscher<sup>2</sup> and Roberto Traversari, PhD<sup>1</sup>, (1)TNO, Aalst, Netherlands, (2)TNO, Gorinchem, Netherlands*

**7. Human-Centric Sensing Parameters for Indoor Air Quality and Thermal Comfort in Office Environments**

*Tianqi Liu, Bowen Du, Dolaana Khovalyg, Associate and Dusan Licina, EPFL, Fribourg, Switzerland*

**8. Effects Of Natural Fiber Clothing On Thermal Sensation And Skin Temperature: A Comparative Study Of Linen, Cotton, And Polyester Materials**

*Satoru Kodama<sup>1</sup>, Aakriti Shrestha<sup>2</sup> and Takafumi Shimizu<sup>3</sup>, (1)Shimane University, Hiroshima, Japan, (2)Shimane University, Matsue, Japan, (3)Shimane University, Matsue, Japan*

**9. Understanding Mold Growth in Bathroom Environments: A Study on Seasonal Thermal Variations within Bathtub Aprons**

*Takafumi Shimizu<sup>1</sup>, Aakriti Shrestha<sup>2</sup> and Thomas Weiser<sup>2</sup>, (1)Shimane University, Matsue, Japan, (2)Shimane University, Matsue, Japan*

**10. Occupant Experiences with Net Zero Energy Homes: Perceived Decarbonization Benefits Beyond Energy**

*Kayla Anne Bortolon, Herb Yaptinchay, Ben Clarin, Maggie Sheng, Associate, Mazen Daher, Affiliate and Sara Beaini, Associate, EPRI, Oak Ridge, TN*

2:00 PM - 3:30 PM

Paper Session 7

Health and Energy Outcomes of IEQ

Room: Ravel

Chair:

**1. Connecting a Healthy Building Microbiome with Indoor Environmental Quality for a Sustainable Future**

*Sarah Gudeman, Full Member<sup>1</sup>, Sarah Haines, PhD, Member<sup>2</sup>, Marcel Harmon<sup>3</sup> and Stephanie Taylor, MD, M Arch, Full Member<sup>4</sup>, (1)BranchPattern, Omaha, NE, (2)University of Toronto, Toronto, ON, Canada, (3)BranchPattern, Kansas City, AR, (4)ThinkLite Air, Stowe, VT*

**2. IAQ Assessment Index For Smart Ventilation Systems**

*Benoit Golaz, Mirela Robitu and Camille Lefebvre, CETIAT, Villeurbanne, France*

**3. Estimating Indoor Heat-Related Health Impacts in Social Housing Using DALYs: A Preliminary Framework**

*Gioberti Raul Morantes Quintana, Akshit Gupta, Giulia Paoletti, Roberto Lollini and Francesco Babich, Eurac, Bolzano, Italy*

**4. Health-based Monetary Costs of 44 Harmful Office Air Contaminants**

*Gioberti Raul Morantes Quintana<sup>1</sup>, Francesco Babich<sup>1</sup>, Roberto Lollini<sup>1</sup>, Max Sherman<sup>2</sup>, Constanza Molina, Full Member<sup>3</sup> and Benjamin Michael Jones, PhD, Full Member<sup>2</sup>, (1)Eurac, Bolzano, Italy, (2)University of Nottingham, Nottingham, United Kingdom, (3)PUC, Santiago, Chile*

2:00 PM - 3:30 PM

### Workshop 3 (Intermediate)

## Non-Energy Impacts: Exploring the Nexus of IEQ and Decarbonization in Residential Buildings

Room: Opus Ballroom

Chair: James McGrath, Maynooth University, Maynooth, Ireland

This workshop will explore the non-energy impacts of building decarbonization, specifically examining how indoor environmental quality (IEQ) and decarbonization intersect in residential buildings. With a focus on a holistic approach, participants will engage with the challenges and opportunities involved in integrating IEQ improvements with decarbonization strategies, especially when retrofitting existing buildings. The workshop will offer insights into how these strategies can enhance occupant health, comfort, and well-being while reducing carbon emissions. Participants will explore current hurdles and potential breakthroughs, fostering dynamic discussions. Attendees will examine key regulatory and policy frameworks that support this integration, discover emerging technologies that enhance both IEQ and energy performance, and explore the social and behavioral dimensions of sustainable building practices. Through interactive discussions and collaborative sessions, the workshop will encourage interdisciplinary exchange on innovative solutions and global best practices. This workshop aims to inspire transformative approaches to decarbonization that prioritize both environmental and occupant-centered outcomes in residential buildings, driving sustainable change on a global scale.

### 1. Retrofitting and Ventilation: Challenges, Benefits and Lessons Learnt

James McGrath, Maynooth University, Ireland, Kildare, Ireland

### 2. Beyond Energy Savings: Making the Link to Health and Decarbonization

Iain Macdonald, National Research Council Canada, Ottawa, ON, Canada

2:00 PM - 3:30 PM

### Workshop 4 (Intermediate)

## Unlocking Energy Efficient Ventilative Cooling Through Emerging CEN & ISO Standards

Room: Concerto

Chair: Christoffer Plesner

Join us for an insightful session as we delve into the latest insights for overheating mitigation using design guidance of ventilative cooling systems (free cooling) in combination with supplementary or mechanical cooling to reach acceptable thermal comfort and further how to unlock and leverage this content from emerging CEN & ISO standards into potential national legislations. In this dynamic session, experts from various disciplines will converge to explore the content and usability of the applied methods in the upcoming standards, discussing insights of the long writing process, while also leaving good time for discussions in the latter part of the session. The purpose of this session is to: 1) Give an overview of how ventilative cooling (free cooling), either alone or in combination with e.g. mechanical cooling fits in the standardisation world through new emerging CEN & ISO standards for design of ventilative cooling systems 2) What are the gaps in current international standards and how ventilative cooling can fit into current and future standards (e.g. EN and ISO standards) 3) Give examples on how ventilative cooling has been implemented into USA buildings and how the new developed ventilative cooling potential method compares against dynamic simulations. 4) Highlight the revised CIBSE AM10 (UK guidance document) and its ability to take Ventilative Cooling into account as well as its influence on documents like ASHRAE. 5) Discuss insights and discussions from the developing process in the upcoming CEN & ISO standards on ventilative cooling 6) Have an interactive discussion on the design paths to secure an optimal ventilative cooling design and receive input from the audience on subjects to be included in these design paths and how to implement these standards at national level.

### 1. Workshop Introduction

Christoffer Plesner, VELUX A/S, DK, HØRSBOLM, Denmark

### 2. Case Studies from USA and Ireland - Ventilative Cooling as part of an Integrated Efficient Design solution

Jannick Roth, WindowMaster International A/S, Denmark, HØRSBOLM, Denmark

### 3. Overview and Insights from the Developing Process of “final” new emerging CEN and ISO Standards on ventilative cooling

Christoffer Plesner, VELUX A/S, Denmark, HØRSBOLM, Denmark

### 4. Effect Of Revised CIBSE AM10 (Natural Ventilation Guidance Document) on Technical Documents like ASHRAE (e.g. including elevated air flows and adaptive comfort approach)

Benjamin Michael Jones, PhD, Full Member, University of Nottingham, UK, Nottingham, United Kingdom

### 5. Practical Application of Ventilative Cooling - A 9 Key Step Design Process for good Ventilative Cooling performance

Paul O'Sullivan, Munster Technological University, Ireland, Cork, Ireland

Wednesday, September 24, 4:00 PM - 5:00 PM

**Paper Session 8**

**Indoor Contaminant Control**

Room: Opus Ballroom

Chair:

**1. Investigate the Effect of Different Types of Ventilation on the Particle Exposure Risk in Classrooms.**

*Anneloes de Lange<sup>1</sup>, Karin Kompatscher<sup>2</sup> and Roberto Traversari, PhD<sup>1</sup>, (1)TNO, Aalst, Netherlands, (2)TNO, Gorinchem, Netherlands*

**2. Analytical Evaluation of Far-UVC (222 nm) Air Disinfection Efficiency in Indoor Environments Using a Multi-Zonal Model**

*Amin Hadizade, Student and Christopher DeGroot, Western University, London, ON, Canada*

**3. Evaluating the Efficacy of Portable Air Scrubbers in Construction Lab Environments**

*Joseph R. Manuel, Deniz Besiktepe, Ph.D., Anthony E. Sparkling, Soowon Chang, Veronica Brems, Sierra Paul, Adam Muhlenkamp and Grace Kelly, Purdue University, West Lafayette, IN*

**4. The Effect of Ventilation Strategies on Indoor Air Pollution in a Home Built to Future Home Standards**

*Navaneeth Meena Thamban<sup>1</sup>, Thomas J. Bannan<sup>1</sup>, Rongrong Wu<sup>1</sup>, Ujjawal Arora<sup>1</sup>, Grant Henshaw<sup>2</sup>, Richard Fitton, PhD<sup>3</sup>, William Swan, PhD<sup>2</sup> and Gordon McFiggans<sup>1</sup>, (1)The University of Manchester, Manchester, United Kingdom, (2)University of Salford, Salford, United Kingdom, (3)University of Salford, Salford, United Kingdom*

4:00 PM - 5:00 PM

**Paper Session 9**

**Components of Thermal Comfort: Humidity and Radiative Heat Transfer**

Room: Concerto

Chair:

**1. Simulation Evaluation of the Humidification Effect in a Residential Ducted Central Air Conditioning System Equipped with a Humidification Device**

*Naoyamaguchi<sup>1</sup>, Daisuke Umemoto<sup>2</sup>, Keiko Sekiya<sup>2</sup>, Hiroshi Nakagawa<sup>2</sup>, Keizo Yokoyama<sup>1</sup> and Takashi Akimoto<sup>1</sup>, (1)Shibaura Institute of Technology, Tokyo, Japan, (2)Panasonic Homes Co., Osaka, Japan*

**2. Novel Method to Estimate Radiative Heat Transfer on Human Body Using Spherical Thermography**

*Shohei Yasuda<sup>1</sup>, Takashi Asawa<sup>2</sup> and Tsuyoshi Ueno<sup>1</sup>, (1)Central Research Institute of Electric Power Industry, Kanagawa, Japan, (2)Institute of Science Tokyo, Tokyo, Japan*

**3. Hygrothermal Performance of Cool Exterior Wall Materials for Urban Heat Island Mitigation in Toronto, Montreal, and Vancouver**

*David Lefebvre, Student<sup>1</sup>, Cynthia A. Cruickshank<sup>1</sup> and Zahra Jandaghian, PhD, Member<sup>2</sup>, (1)Carleton University, Embrun, ON, Canada, (2)National Research Council Canada, Ottawa, ON, Canada*

4:00 PM - 5:00 PM

**Paper Session 10**

**Gas Applications and Pathogen Sensing**

Room: Ravel

Chair:

**1. Enhanced Photocatalytic Oxidation of Indoor Air VOCs Using TiO<sub>2</sub>-WO<sub>3</sub> Photocatalyst Under Visible Light Irradiation: Efficiency and Byproducts Assessment**

*Parham Haghighi Boroujeni, Student and Fariborz Haghighat, Concordia University, Montréal, QC, Canada*

**2. Impact of Temperature on Gas-Phase Phthalate Emissions in a Developed Source Generation System: Insights for Indoor Air Quality**

*Azad Bahrami<sup>1</sup>, Fariborz Haghighat<sup>2</sup> and Jiping Zhu<sup>3</sup>, (1)Concordia University, Montreal, QC, Canada, (2)Concordia University, Montréal, QC, Canada, (3)Health Canada, Ottawa, ON, Canada*

**3. Rhizosphere Bacterial Responses to Gasoline Vapour Pollutants: Changes in BTEX Degradation and Enzymatic Activity**

*Luowen Lyu, Stephen Matheson, Peter Irga and Fraser Torpy, University of Technology Sydney, Sydney, NSW, Australia*

**4. Real-Time Biosensor Technology Platform for Enhanced Pathogen Control and Efficiency**

*Phil Arnold, VP Engineering, Associate, Safetraces, Pleasanton, CA*

4:00 PM - 5:00 PM

**Paper Session 11**

**Pollutants and Particle Effects**

Room: Tchaikovsky

Chair:

**1. The Implementation of Stand-alone Air Cleaners in Ventilated and Non-ventilated Meeting Rooms for the Mitigation of the Airborne Particles**

*Mirela Robitu, Alain Ginestet, Benoit Golaz, Dominique Pugnet, Lionel Boiteux and Jean-Marc Thiebaut, CETIAT, Villeurbanne, France*

**2. Evaluation Of Air And Pollutant Transport In An Apartment With Balanced Ventilation: Measurement And Simulation Study**

*Mirela Robitu, Laure Mouradian, Alain Ginestet, Camille Lefebvre and Dominique Pugnet, CETIAT, Villeurbanne, France*

**3. Investigating Particle and VOC Emissions from Artificial Turf in Controlled Conditions**

*Chang Shu, Rea, Simon Hunt, Fatima Sultani, Qixuan Li, Andy Dinh and Liang {Grace} Zhou, National Research Council Canada, Ottawa, ON, Canada*

**Thursday, September 25**

Thursday, September 25, 9:30 AM - 10:30 AM

**Paper Session 12**

**Canadian Indigenous Housing and Cross-World Radon Control Practices**

Room: Opus Ballroom

Chair:

**1. Indoor Environmental Quality In Remote And Northern Indigenous Housing In Canada**

*Odel Linetska, Student Member<sup>1</sup>, Maria Milan<sup>1</sup>, Helen Stopps<sup>1</sup> and Sarah Haines, PhD, Member<sup>2</sup>, (1)Toronto Metropolitan University, Woodbridge, ON, Canada, (2)University of Toronto, Toronto, ON, Canada*

**2. Comparing Radon Remediation strategies : Training and Qualification Processes Across the World**

*Catherine Nauleau, Valerie Leprince, Ponthieux Jocelyne and Boithias Florent, Cerema, Lyon, France*

**3. IEQ in Extremely Cold Climates: A Multi-Method Study of Inuit Homes**

*Jean Rouleau, P.Eng., Ph.D., Student<sup>1</sup> and Louis Gosselin, P.Eng., Ph.D., S-B-a Member<sup>2</sup>, (1)Université Laval, Quebec City, QC, Canada, (2)Université Laval, Quebec city, QC, Canada*

9:30 AM - 10:30 AM

**Paper Session 13**

**Ventilation System Energy Use**

Room: Concerto

Chair:

**1. Performance-Based Approach Simulation to Compare IAQ and Energy Performance of Two Types of Ventilation Systems Inside Individual Houses and Multifamily Buildings**

*Ali Alexandre Nour Eddine<sup>1</sup>, Zohreh Kiani<sup>1</sup> and Marc Abadie, PhD<sup>2</sup>, (1)Eurovent, Paris, France, (2)La Rochelle University, La Rochelle, France*

**2. Energy Analysis of Balanced Ventilation Units with Exhaust Air Heat Pumps**

*Bart Cremers<sup>1</sup>, Adam O'Donovan<sup>2</sup> and Paul D. O'Sullivan<sup>2</sup>, (1)Zehnder Group Zwolle, Zwolle, Netherlands, (2)Munster Technological University, Cork, Ireland*

**3. Measuring The Performance Of A Centralized And Decentralized Ventilation System In Two Multi-Unit Residential Buildings**

*Justin Berquist<sup>1</sup>, Marianne Touchie, PhD, Member<sup>2</sup> and William O'Brien<sup>3</sup>, (1)National Research Council Canada, Ottawa, ON, Canada, (2)University of Toronto, Toronto, ON, Canada, (3)Carleton University, Ottawa, ON, Canada*

9:30 AM - 10:30 AM

**Paper Session 14**

**IEQ and Acoustics**

Room: Ravel

Chair:

**1. Bridging the Gap: Defining and Benchmarking Acoustical Objectives for Occupant-Centric IEQ**

*Viken Koukounian, Ph.D., P.Eng., Associate Member, Parklane Mechanical Acoustics, Oakville, ON, Canada*

**2. Harmonizing Acoustics, IEQ, and Sustainability in Higher Education Buildings**

*Josh Thede, BrightTree Studios, Warrendale, PA*

**3. A Unified Metric for Speech Privacy in Open and Closed Office Environments**

*Rewan Toubar<sup>1</sup>, Joonhee Lee, P.Eng., Associate<sup>2</sup> and Roderick Mackenzie, Ph.D., INCE Bd. Cert., FIOA<sup>3</sup>, (1)Concordia University, Gatineau, QC, Canada, (2)Concordia University, Montreal, QC, Canada, (3)Soft dB Inc, Mont-Royal, QC, Canada*

9:30 AM - 10:30 AM

**Paper Session 15**

**Tools for Envelope Leak Detection and Evaluation**

Room: Tchaikovsky

Chair:

**1. Acoustic Leak Detection in Building Envelopes – Laboratory and Field Tests**

*Björn Schiricke<sup>1</sup>, Markus Diel<sup>1</sup>, Alexander Jahnke<sup>2</sup> and Michael Markus Ackermann<sup>2</sup>, (1)German Aerospace Center, Cologne, Germany, (2)Society for the Advancement of Applied Computer Science, Berlin, Germany*

**2. Pressure Inversion for Leakage Detection at Building Envelopes with Lock-In Thermography**

*Johannes Pernpeintner<sup>1</sup> and Markus Diel<sup>2</sup>, (1)Deutsches Zentrum für Luft- und Raumfahrt e.V., Cologne, Germany, (2)German Aerospace Center, Cologne, Germany*

**3. Aerosol Sealing Occupied Residences From Exterior Spaces**

*Dave Bohac<sup>1</sup>, Curtis Harrington, PE, Student<sup>2</sup>, Mike Lubliner<sup>3</sup>, Mike Lyon<sup>4</sup>, Frederick Nicholas Meyers, Associate<sup>2</sup> and Timothy Levering<sup>2</sup>, (1)Center for Energy and Environment, Minneapolis, MN, (2)UC Davis, Davis, CA, (3)Oak Ridge National Laboratory, Olympia, WA, (4)Aeroseal, Miamisburg, OH*

Thursday, September 25, 11:00 AM - 12:30 PM

**Paper Session 16**

**Residential Occupant Behavior**

Room: Ravel

Chair:

**1. How Do Teleworkers Use Thermostats and Equipment at Home?**

*Melina Sirati<sup>1</sup>, William O'Brien<sup>2</sup> and Cynthia A. Cruickshank<sup>2</sup>, (1)Carleton university, Ottawa, ON, Canada, (2)Carleton University, Ottawa, ON, Canada*

**2. Tropical Sleep Environments: How Thermal Adaptive Behaviors Enhance Thermal Comfort And Sleep Quality**

*Kyohei Kondo<sup>1</sup>, Tepei Tsuchiya<sup>2</sup>, Takashi Asawa<sup>1</sup>, Tomonori Sakoi<sup>2</sup>, Tetsu Kubota<sup>3</sup>, Sri Nastiti Nugrahani Ekasiwi<sup>4</sup>, Usep Surahman<sup>5</sup> and Mochamad Donny Koerniawan<sup>6</sup>, (1)Institute of Science Tokyo, Tokyo, Japan, (2)Shinshu University, Matsumoto, Japan, (3)Hiroshima University, Higashi-Hiroshima, Hiroshima, Japan, (4)Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia, (5)Universitas Pendidikan Indonesia, Bandung, Indonesia, (6)Institut Teknologi Bandung, Bandung, Indonesia*

**3. Comparison Between Asset Rating Design Assumptions And Measured Internal Temperatures for Homes With Heat Pumps: Observations from Ireland**

*James Pittam<sup>1</sup>, Shane Colclough<sup>2</sup>, Leon Domoney<sup>1</sup>, Donal Lennon<sup>3</sup>, Paul O' Sullivan<sup>1</sup>, Oliver Kinnane<sup>3</sup> and Adam Cornelius O Donovan<sup>1</sup>, (1)Munster Technological University, Cork, Ireland, (2)Energy Expertise Ltd, Kildare, Ireland, (3)University College Dublin, Dublin, Ireland*

**4. Assessing the Interactions Between Energy Poverty, Occupant Behavior and Indoor Air Quality in Irish Households**

*James McGrath<sup>1</sup>, Celine Fox<sup>2</sup>, Pan Zhou<sup>1</sup>, Afshin Saeedian<sup>3</sup>, Reihaneh Aghamolaei<sup>3</sup>, Miriam Byrne<sup>4</sup>, James O'Donnell<sup>5</sup> and Shane Timmons<sup>2</sup>, (1)Maynooth University, Maynooth, Ireland, (2)Economic and Social Research Institute, Dublin, Ireland, (3)Dublin City University, Dublin, Ireland, (4)University of Galway, Galway, Ireland, (5)University College Dublin, Dublin, Ireland*

**5. Wi-Fi Sensing for Improving Air Quality and Thermal Comfort in Residential Buildings**

*Reza Daneshazarian, Student, Seungjae Lee, Ph.D., Associate and Jeffrey A Siegel, PhD, Fellow S-B-a Member, University of Toronto, Toronto, ON, Canada*

11:00 AM - 12:30 PM

### Paper Session 17

## Influencing Factors and Metric Assessment

Room: Tchaikovsky

Chair:

### 1. Characterizing Office Smellscape Perception through Participatory Approaches and Natural Language Processing (NLP) Techniques

*Giulia Torriani<sup>1</sup>, Simone Torresin<sup>2</sup>, Francesco Babich<sup>1</sup> and Rossano Albatichi<sup>2</sup>, (1)Institute for Renewable Energy - Eurac Research, Bolzano, Italy, (2)University of Trento, Trento, Italy*

### 2. Frequency Based Assessment of Smart Ventilation

*Jelle Laverge<sup>1</sup>, Merel Decluyre<sup>2</sup>, Lisa Corneillie<sup>3</sup> and Klaas De Jonge<sup>1</sup>, (1)Ghent University, Ghent, Belgium, (2)Ghent University, Zottegem, Belgium, (3)Ghent University, Ruddervoorde, Belgium*

### 3. Variables Affecting Indoor Environmental Quality of Buildings: A Critical Review

*Sunday Segbenu Nunayon and Lexuan Zhong, University of Alberta, Edmonton, AB, Canada*

### 4. The Impact of Personal and Contextual Factors on Multi-domain Subjective Comfort Responses in Classrooms

*Federica Morandi<sup>1</sup>, Andrea Gasparella, Professor<sup>1</sup>, Athanasios Tzempelikos, PhD, Full Member<sup>2</sup>, Ilaria Pittana<sup>3</sup> and Francesca Cappelletti<sup>4</sup>, (1)Free University of Bolzano, Bolzano, Italy, (2)Purdue University, West Lafayette, IN, (3)Iuav University of Venice, Venice, Italy, (4)Iuav University of Venice, Venezia, Italy*

11:00 AM - 12:30 PM

### Workshop 5 (Intermediate)

## Real-life examples of implementing 'resilience': applying ASHRAE Standard 241 'Control of Infectious Aerosols' and Guideline 44 'Protecting Building Occupants from Smoke During Wildfire'

Room: Opus Ballroom

Chair: Jelle Laverge, Ghent University, Ghent, Belgium

In this seminar, we will present the current state of the art on 'resilience' and discuss case studies of the implementation of the concept in the ASHRAE Standard 241 and Guideline 44 in real projects. The seminar is designed to gather insights from the practical implementation of these new resilience based documents. Participants will have the opportunity to share and discuss their experiences, challenges, and successes.

### 1. Resilience As A New Paradigm For IEQ Assessment: A Short Introduction

*Jelle Laverge, Ghent University, Belgium, Ghent, Belgium*

### 2. Quantitative Metrics For Resilience

*Hilde Breesch, KU Leuven, Belgium, Leuven, Belgium*

### 3. Case Study 1: applying ASHRAE Standard 241 "Control of Infectious Aerosols"

*Benjamin Michael Jones, PhD, Full Member, University of Nottingham, UK, Nottingham, United Kingdom*

### 4. Case Study 2: applying ASHRAE Guideline 44 "Protecting Building Occupants from Smoke During Wildfire"

*Max Sherman, EPB CONSULTING GROUP, Moraga, CA*

11:00 AM - 12:30 PM

### Workshop 6 (Intermediate)

## Dimensions of Indoor Environmental Quality for Healthy Aging in Place

Room: Concerto

Chair: Jennifer Veitch, National Research Council of Canada, Canada, Ottawa, ON, Canada

The global population is aging: The World Health Organization notes that in 2020 the global population of people over 60 years of age exceeded the number of children younger than 5, and by 2050 the percentage of people over 60 years old will be approximately 22%. The proportion in Canada is projected to be higher, approximately 1 in 4, by 2050. The vast majority of Canadians (~85%) would prefer to remain in their own homes for as long as possible, which is known as "aging in place". There are societal benefits to aging in place as well as individual benefits; preventive and community-based care for an individual who needs support for activities of daily living is much less costly than a long-term care home. In response to this reality, the National Research Council of Canada created the Aging in Place Challenge Program to develop technologies and innovations to enable older Canadians to remain in their own homes as they age. Among the innovations that may be required are changes to the built environment. Building codes and standards exist to provide a lower bound to indoor environmental quality (IEQ), what might be called "the worst IEQ that one is permitted to build". Operating guidelines are intended to support good or best-practice operation for healthy IEQ, but individuals will succeed in this only to the extent that they have the correct features or technologies in their

homes and the ability and knowledge to use them effectively. Moreover, the research underlying all of these guidance documents has considered primarily the abilities and needs of healthy young or middle-aged adults. Older adults, particularly those who might have multiple chronic health conditions, might need different indoor environmental conditions than those for whom existing guidance was written. This session will report on four aspects of a multi-task, multi-party collaborative research project in the NRC Aging in Place Challenge Program titled “Establishing Guidance for Indoor Environmental Conditions for Healthy Aging in Place,” providing early results from different aspects of the work. The first paper will summarize key findings from an online population survey of Canadian seniors, their IEQ satisfaction across the domains of temperature, ventilation, acoustics, and lighting, their current quality of life, and their plans for their future housing. The second paper, presented by a colleague from AIST in Japan, will report on a collaborative quasi-experiment testing the effects of outdoor-to indoor transmission of traffic noise on older adults’ sleep. This will be followed by two presentations deriving from a 12-month field study in 29 homes of older Canadians of their indoor environmental conditions, health status, IEQ satisfaction, and sleep. The first of these will describe the development of a tool to assess the adaptive opportunities that older adults may have available to them in their homes to improve their IEQ, taking into account the availability, functional status, and characteristics of adaptive opportunities from field study observations and the literature. The second paper will report specifically on the availability of adaptive opportunities for changing the thermal environment among these participants. Following the presentations, the co-chairs will moderate an open discussion with audience members. We anticipate that this discussion will contribute to deeper understanding of the issues involved in providing comprehensive and integrated IEQ guidance for healthy aging in place, both in Canada and around the world.

**1. Indoor Environmental Satisfaction and Quality of Life among Older Canadians: Preliminary Survey Results**

*Jennifer Veitch, National Research Council of Canada, Canada, Ottawa, ON, Canada*

**2. Environmental Noise and Sleep Quality Among Older Adults: Pilot Study and Initial Discussion**

*Hiroshi Sato, National Institute of Advanced Industrial Science and Technology (AIST), Japan, Tokyo, Japan*

**3. Development of an Assessment Tool of Adaptive Opportunities to Adjust IEQ Conditions for Aging in Place**

*Hannah Villeneuve, Carleton University, Ottawa, ON, Canada*

**4. Residential Indoor Thermal Adaptive Behaviour Availability and Use for Older Adults in Canada**

*Kelsey Eakin, University of Toronto, Toronto, ON, Canada*

**5. Indoor Environmental Quality to Meet the Needs of Older Residents: Discussion on How to Create Effective Standards and Guidelines**

*Hiroshi Sato, National Institute of Advanced Industrial Science and Technology (AIST), Japan, Tokyo, Japan*

Thursday, September 25, 2:00 PM - 3:30 PM

**Poster Session 2**

**Poster Session 2**

*Room: Tchaikovsky*

*Chair:*

**1. Assessment of Leakage Detection Method for Building Interior Walls Using Thermal Infrared Imaging**

*Hee Won Shin, Jabin Goo, Ji Min Kim and Dong Hwa Kang, University of Seoul, Seoul, South Korea*

**2. Sustainable Indoor Environmental Quality: A New Model For Building Performance Assessment**

*Oluwafemi Awolesi, Margaret Reams and Joshua Emeghai, Louisiana State University, Baton Rouge, LA*

**3. Preliminary Field Study Findings on Comfort in Ottawa's Social Housing**

*Kala Sewraj, Pedram Nojedehi and William O'Brien, Carleton University, Newmarket, ON, Canada*

**4. Development of A Design Method to Enhance Actual Energy Performance of Energy Recovery Ventilators in Buildings**

*Tetsutoshi Kan<sup>1</sup>, Satoru Mineno<sup>2</sup> and Takao Sawachi<sup>3</sup>, (1)Center for Better Living, Tsukuba, Japan, (2)AE-Solutions, Tokyo, Japan, (3)Building Research Institute, Japan, Tokyo, Japan*

**5. Optimizing Comfort And Energy-saving Performance Of Floor Heating System Focusing On The Time Dependence Of Thermal Sensation**

*Takafumi Shimizu<sup>1</sup>, Keiji Nakaso<sup>2</sup>, Aakriti Shrestha<sup>1</sup> and Thomas Weiser<sup>1</sup>, (1)Shimane University, Matsue, Japan, (2)Wood's Company, Matsue, Japan*

**6. Field Measured Airtightness of Heritage Buildings**

*Yash Pareskumar Vyas<sup>1</sup>, Justin David Berquist, PhD (c), PEng, Associate<sup>2</sup>, Russell Richman<sup>1</sup> and Michal Bartko<sup>2</sup>, (1)Toronto Metropolitan University, Scarborough, ON, Canada, (2)National Research Council Canada, Ottawa, ON, Canada*

**7. Ai-Enhanced Kinetic Shading: Revolutionizing Ventilation Efficiency In Residential Buildings For Hot Arid Climates**

*H Abhila<sup>1</sup>, Karupiah Ayeratharasu Rajasekharan<sup>2</sup>, R Karthik<sup>3</sup>, V R Prasath kumar<sup>1</sup> and L Krishnaraj<sup>1</sup>, (1)SRM Institute of Science and Technology, Tamil Nadu, India, (2)Veracity Plus Private Ltd, Chennai, India, (3)Veracity Plus Private Ltd, Tamil Nadu, India*

**8. Evaluation of Workers' Sensation Caused by the Arrangement of Plantings in Office Space**

*Chinatsu Nishida<sup>1</sup>, Hiroshi Ishihara<sup>1</sup>, Hidehiko Shibata<sup>2</sup>, Aakriti Shrestha<sup>3</sup> and Takafumi Shimizu<sup>1</sup>, (1)Shimane University, Matsue, Japan, (2)San-in Elevator Co., Ltd, Matsue, Japan, (3)Shimane University, Matsue, Japan*

**9. How Healthy are the Millions of Domestic Kitchen Constructed in Asian-Pacific LMIC Each Year: A Field Study**  
*Juliet Landler, University of Technology Sydney, North Rocks, NSW, Australia*

**10. Impacts of User Behaviour on Portable Air Cleaner Performance**

*Alexander Y. Mendell, Seungjae Lee, Ph.D., Associate and Jeffrey A. Siegel, University of Toronto, Toronto, ON, Canada*

**11. Bespoke Testing of Filtration Systems to Ensure Air Quality in Trains**

*John McKeon<sup>1</sup>, John Ryan<sup>2</sup>, Angela Southey<sup>2</sup>, Josh Ryan<sup>3</sup>, Oliver Dsa<sup>2</sup> and Himangi Das<sup>2</sup>, (1)iAIR Institute, Dublin, Ireland, (2)Airmid Healthgroup, Dublin, Ireland, (3)Allergy Standards Ltd, Dublin, Ireland*

**12. IEQ Confluence: A Pathway For Implementing ASHRAE Guideline 10**

*Carl Grimes, HHS CIEC, Full Member, Hayward Healthy Home Institute, Monterey, CA*

2:00 PM - 3:30 PM

**Paper Session 18**

## **Post-COVID Operation Application and Technology**

*Room: Ravel*

*Chair:*

**1. Energy-Efficient Solutions for Improving Indoor Air Quality and Reducing Carbon Emissions in a Canadian School: The Role of Silver-Graphene Oxide Treated HVAC air Filters**

*Deepak Sridhar, PhD, PEng, Associate<sup>1</sup>, Kathleen Owen, Engineering Consultant, Fellow Member<sup>2</sup>, Frank Mesicek<sup>3</sup>, Ryan Shacklock, Associate Member<sup>1</sup> and Colin van der Kuur, Associate Member<sup>1</sup>, (1)Zentek Ltd, Guelph, ON, Canada, (2)Owen Air Filtration Consulting, LLC, Cary, NC, (3)Grand Erie District School Board, Brantford, ON, Canada*

**2. Innovative Ventilation System For Public Spaces : Economic Study, IAQ Performance And Airborne Infection Risk Evaluation In Various Settings**

*Sophie Bernard, Sara Verheyleweghen, Sébastien Pecceu and Samuel Caillou, Buildwise, Limelette, Belgium*

**3. Investigating Ventilation Strategies on Public Transport through the Long-Term Environmental Monitoring of Operational London Buses**

*Oliver Wild, Filipa Adzic and Liora Malki-Epshtein, University College London, London, United Kingdom*

**4. A Simple Method for Estimating Exhaled Carbon Dioxide Emissions Using Measured Equivalent Sound Pressure Level**

*Yoshinori Honma<sup>1</sup>, Kei Shimonosono, Dr.Eng, Associate<sup>1</sup>, Kenichi Azuma<sup>2</sup>, Dai Shimazaki<sup>1</sup>, Naoe Nishihara<sup>3</sup>, Kenichi Kobayashi<sup>1</sup> and Michiko Bando<sup>1</sup>, (1)National Institute of Public Health, Wako, Saitama, Japan, (2)Kindai University, Osaka, Japan, (3)Japan Women's University, Tokyo, Japan*

**5. Impact of Increased Ventilation Rates in Classrooms on Energy Usage and System Functionality in a US Midwest climate**

*Ulrike Passe<sup>1</sup>, Jack Farrar<sup>2</sup> and Derenik Mahmoodi<sup>2</sup>, (1)Iowa State University College of Design, Dept. of Architecture, Ames, IA, (2)Iowa State University, Ames, IA*

2:00 PM - 3:30 PM

**Workshop 7 (Intermediate)**

## **IEA EBC Annex 86: a Rating Ecology for IAQ Management in Residential Buildings**

*Room: Opus Ballroom*

*Chair: Jelle Laverge, Ghent University, Ghent, Belgium*

IEA-EBC Annex 86 is a recently concluded international research collaboration of 43 institutes spread over 24 countries, working together to propose a coherent framework for the rating of iaq management strategies in residential buildings. In this workshop, they are presenting the result of that 4 year long effort, giving an overview of key insights as well as ongoing and planned implementation work in standards. The seminar will conclude with an interactive session where attendees can vote on the priorities for new initiatives.

**1. Workshop Introduction**

*Jelle Laverge, Ghent University, Ghent, Belgium*

**2. The other 'denli**

*Benjamin Michael Jones, PhD, Full Member, University of Nottingham, Nottingham, United Kingdom*

**3. Opening Pandora's box**

*Marc Abadie, PhD, Laroche Université, La Rochelle, France*

**4. The Magic Sponge of IAQ**

*Jianshun Zhang, Syracuse University, Syracuse, NY*

**5. The ventilation IQ test**

*Jelle Laverge, Ghent University, Belgium, Ghent, Belgium*

2:00 PM - 3:30 PM

## Workshop 8 (Intermediate)

### Durability of the Building Airtightness

Room: Concerto

Chair: Valerie Leprince, Cerema, Lyon, France and Andres Litvak, Cerema, Lyon, France

Air leakages increasingly affect the energy performance of new buildings. Since the early 2000s, many countries have introduced regulations that emphasize airtightness, including mandatory standards, aligning with Europe's goal of achieving nearly zero energy buildings by 2030. However, building airtightness requirements are only effective if the levels remain durable over time. Studies reveal that these mandates often lead to last-minute sealing efforts, compromising durability.

The long-term durability of airtightness products and assemblies remains a complex issue, involving:

- Modeling the mechanical behavior and deformations of buildings and products,
- Laboratory-based accelerated aging tests,
- Field measurements for performance characterization.

#### 1. State of the Art of Knowledge on Building Airtightness Durability

Valerie Leprince, Cerema, Lyon, France

#### 2. Understanding Early Airtightness Variations: Lessons from 10 Residential Case Studies

Sylvain Berthault, Cerema, Lyon, France

#### 3. From Site to Lab: Evaluating Implementation Conditions and Reproducing Them in Laboratory

Andres Litvak, Cerema, Lyon, France

#### 4. Experimental Measurement Results of the Impact of Surfaces Sust Built-up and Temperature on Building Airtightness Durability

Andres Litvak, Cerema, Lyon, France

Thursday, September 25, 4:00 PM - 5:00 PM

## Paper Session 19

### IAQ Roadmap, IAQ Insights, and Bioaerosols

Room: Opus Ballroom

Chair:

#### 1. ACGIH Bioaerosols Book - Assessment And Control, 2nd Edition

Donald Munson Weekes<sup>1</sup>, Cheri Marcham<sup>2</sup> and Jack Springston<sup>3</sup>, (1)Retired, Ottawa, ON, Canada, (2)Embry-Riddle Aeronautical University, Newcastle, OK, (3)Atlas Technical Consultants, Glen Head, NY

#### 2. Indoor Air Quality Perceptions: Insights from a Cross-Sector Survey

Grace Dickinson and Sara Karerat, Center for Active Design, Brooklyn, NY

#### 3. Policy and Regulatory Roadmap to Achieve Health-Based Indoor Air Quality Standards

William P Bahnfleth, Ph.D., P.E., Presidential Fellow Life SBA Member<sup>1</sup>, Georgia Lagoudas<sup>2</sup> and Erik Malmstrom, Affiliate<sup>3</sup>, (1)Pennsylvania State University<sup>7</sup>, State College, PA, (2)Brown University, Washington, DC, (3)Safetraces, Pleasanton, CA

4:00 PM - 5:00 PM

## Paper Session 20

### Energy Retrofit Effects

Room: Concerto

Chair:

#### 1. Numerical Analysis of Energy Retrofits Impacts on Indoor Thermal and Air Quality of Single-Family Houses

Marc Abadie, PhD<sup>1</sup>, Picard Charles-Florian<sup>2</sup>, Nicolle Jérôme<sup>2</sup>, Wall-Ribot Bénédicte<sup>3</sup> and Cordeiro Mendonça Katia<sup>2</sup>, (1)La Rochelle University, La Rochelle, France, (2)TIPEE Plateforme Technologique du Bâtiment Durable, Lagord, France, (3)EDF R&D, Moret-sur-Loing, France

#### 2. Assessing the Air Change Rates Pre and Post Residential Energy Retrofit Using CO<sub>2</sub>, Temperature, Relative Humidity and Motion Sensors

Sameeraa Soltanian-Zadeh<sup>1</sup>, Shayan Mirzabeigi<sup>1</sup>, Bess Krietemeyer<sup>2</sup> and Jianshun "Jensen" Zhang<sup>2</sup>, (1)State University of New York College of Environmental Science and Forestry, Syracuse, NY, (2)Syracuse University, Syracuse, NY

#### 3. Residential Retrofitting: Integrated Building Performance Evaluation

Sahil Ali Khan<sup>1</sup>, Richard O'Hegarty<sup>1</sup>, Donal Finn<sup>1</sup>, Adam O'Donovan<sup>2</sup>, Leon Domoney<sup>2</sup>, Shane Colclogh<sup>1</sup>, Donal Lennon<sup>1</sup>, Paul O'Sullivan<sup>2</sup> and Oliver Kinnane<sup>1</sup>, (1)University College Dublin, Dublin, Ireland, (2)Munster Technological University, Cork, Ireland

4:00 PM - 5:00 PM  
Paper Session 21

## Indoor and Outdoor Particulates

Room: Ravel

Chair:

### 1. Quantifying Health Benefits of Stricter PM Standards: A Comparison of EU and WHO Annual Guidelines

*Lisa Corneillie<sup>1</sup>, Klaas De Jonge<sup>2</sup> and Jelle Laverge<sup>2</sup>, (1)Ghent University, Ruddervoorde, Belgium, (2)Ghent University, Gent, Belgium*

### 2. Assessing Suburban Air Quality Constraints on Free Cooling in an Irish City

*Paul D O'Sullivan, Theofanis Psomas, Ganga Chinna Rao Devarapu and Adam O'Donovan, Munster Technological University, Cork, Ireland*

### 3. Indoor-Outdoor Particle Ratios and Their Impact on Population Harm Estimates

*Benjamin Michael Jones, PhD, Full Member<sup>1</sup> and Iain S Walker, PhD, Fellow Member<sup>2</sup>, (1)University of Nottingham, Nottingham, United Kingdom, (2)Lawrence Berkeley National Laboratory, Berkeley, CA*

### 4. Exploring the Variability of Indoor-Outdoor Ratio of Particle Matter in Santiago, Chile

*Constanza Molina, Full Member<sup>1</sup>, Congsyuan Chen<sup>2</sup>, Paz Peña-Oyarzún<sup>1</sup>, Benjamin Michael Jones, PhD, Full Member<sup>3</sup>, Iain S Walker, PhD, Fellow Member<sup>4</sup> and Héctor Jorquera<sup>1</sup>, (1)PUC, Santiago, Chile, (2)National Taiwan University of Science and Technology, Taipei, Taiwan, (3)University of Nottingham, Nottingham, United Kingdom, (4)Lawrence Berkeley National Laboratory, Berkeley, CA*

4:00 PM - 5:00 PM  
Paper Session 22

## Airtightness of Building Components

Room: Tchaikovsky

Chair:

### 1. Mind the Gaps: Improving Airtightness Elevator Shafts in Multi-Unit Residential Buildings

*John Nguyen Hoang, Student Member<sup>1</sup> and Marianne F. Touchie<sup>2</sup>, (1)University of Toronto, Oakville, ON, Canada, (2)University of Toronto, Toronto, ON, Canada*

### 2. Using Measured Exponents and Fractional Leakage Flow to Characterize Air Leakage in Ducts

*Federico Pedranzini<sup>1</sup> and Mark Modera<sup>2</sup>, (1)Politecnico di Milano, Milano, Italy, (2)University of California in Davis, Davis, CA*

### 3. Proposal for a Procedure for the Characterization of Air Systems Based on an Extended Model

*Federico Pedranzini<sup>1</sup>, Valerie Leprince<sup>2</sup>, Mark Modera<sup>3</sup>, Nolwenn Hurel<sup>4</sup> and Francesco Romano<sup>1</sup>, (1)Politecnico di Milano, Milano, Italy, (2)Cerema, Lyon, France, (3)University of California in Davis, Davis, CA, (4)Cerema, L'Isle d'Abeau, France*

## Friday, September 26

Friday, September 26, 9:30 AM - 10:30 AM  
Poster Session 3

## Poster Session 3

Room: Tchaikovsky

Chair:

### 1. The Different Nomenclatures And Aspects Of Indoor Environmental Quality (IEQ): Understanding Its Concepts And Its Multidisciplinary Nature

*Iasmin Lourenço Niza, Mateus Pedrosa Braga, Ana Maria Bueno and Evandro Eduardo Broday, Federal University of Technology, Paraná, Brazil*

### 2. Method of Measuring Respiratory Aerosol Size Distributions Before and After Desiccation

*Nicholas Clements, PhD, Full Member<sup>1</sup>, Phil Arnold, VP Engineering, Associate<sup>2</sup>, Haiying Peng<sup>1</sup> and John Zhai<sup>1</sup>, (1)University of Colorado Boulder, Denver, CO, (2)Safetraces, Pleasanton, CA*

### 3. Comparative Analysis of Modelled Energy Performance and Occupant Comfort Pre- and Post-Retrofit of 63-Unit Ottawa Townhome Community

*Sara Sadeghi, Christopher Baldwin and Cynthia A. Cruickshank, Carleton University, Ottawa, ON, Canada*

### 4. Balancing Health Impacts and Environmental Costs in Mechanical Ventilation Systems

*Merel Decleyre<sup>1</sup>, Klaas De Jonge<sup>1</sup> and Jelle Laverge<sup>2</sup>, (1)Ghent University, Zottegem, Belgium, (2)Ghent University, Gent, Belgium*

**5. Non-Invasive Machine Learning Models for Fall Detection in Bathrooms Using Indoor Environmental Data**

*JeongWon Kim, JunSub Kim, SunHo Kim and HyeunJun Moon, Dankook University, Yongin, South Korea*

**6. Within-Building Variability in Summer Thermal Performance: A Case Study of a Swedish Multi-Residential Building**

*Joel Slunitschek and Despoina Teli, Chalmers University of Technology, Göteborg, Sweden*

**7. Distinguishing Individual and Population-Level Infection Risks in Indoor Environments: A Computational Analysis of Ventilation and Social Distancing Effects**

*Ali Asghar Sedighi<sup>1</sup>, Fariborz Haghighat<sup>2</sup> and Fuzhan Nasiri, Professor & Associate Chair, Building, Civil, and Environmental Engineering<sup>1</sup>, (1)Concordia University, Montreal, QC, Canada, (2)Concordia University, Montréal, QC, Canada*

**8. Predicting Energy Consumption and Thermal Comfort in Toronto Buildings Under Extreme Heat Events**

*Nabil Bleibel and Helen Stopps, Toronto Metropolitan University, Mississauga, ON, Canada*

9:30 AM - 10:30 AM

**Paper Session 23**

**Preference-Based Control and Optimization**

*Room: Opus Ballroom*

*Chair:*

**1. Field Implementation of Preference-based Building Thermal Control: Energy and Comfort Assessment**

*Hejia Zhang<sup>1</sup>, Athanasios Tzempelikos, PhD, Full Member<sup>1</sup>, Seungjae Lee, Ph.D., Associate<sup>2</sup>, Andrea Gasparella, Professor<sup>3</sup> and Francesca Cappelletti<sup>4</sup>, (1)Purdue University, West Lafayette, IN, (2)University of Toronto, Toronto, ON, Canada, (3)Free University of Bolzano, Bolzano, Italy, (4)Iuav University of Venice, Venezia, Italy*

**2. Algorithms for Deriving Occupant Preference Ranges in Automatic Control of Air Conditioners**

*Taeyeon Kim<sup>1</sup>, Seheon Kim<sup>1</sup>, Yingdao Nan<sup>1</sup> and Jae-Weon Jeong, Member<sup>2</sup>, (1)Hanyang University, Seoul, South Korea, (2)Dept. of Architectural Engineering, Hanyang University, Seoul, South Korea*

**3. A Reinforcement Learning Model for Cooling Optimization in Existing Residential Apartment Building**

*Seheon Kim, Student<sup>1</sup>, Taeyeon Kim<sup>1</sup>, Yingdao Nan<sup>1</sup> and Jae-Weon Jeong, Member<sup>2</sup>, (1)Hanyang University, Seoul, South Korea, (2)Dept. of Architectural Engineering, Hanyang University, Seoul, South Korea*

9:30 AM - 10:30 AM

**Paper Session 24**

**Gamification And Predictive Control**

*Room: Concerto*

*Chair:*

**1. Model Predictive Control Signal For Natural Ventilation Optimization Using Data-Driven Techniques**

*Benedetta Zuccarelli, Chenjie Xiong, Patrick Margain and Elence Xinzhu Chen, Student, Harvard University, Cambridge, MA*

**2. Behaviour Nudging for User Acceptance in Smart Blinds Control: A Pilot Study on Behaviour Change and Indoor Environmental Enhancement**

*Wen-Ting Li<sup>1</sup>, Alessandra Luna-Navarro<sup>2</sup>, Pedro de la Barra Luegmayer<sup>2</sup>, Michele W.T. Mak<sup>1</sup> and Han Fang<sup>1</sup>, (1)University of Leeds, Leeds, United Kingdom, (2)TU Delft, Delft, Netherlands*

**3. Let's Play! What Serious Gaming Reveals about Occupant Behavior and IEQ**

*Debby Veillette, Ph.D. Candidate, Student<sup>1</sup>, Jean Rouleau, P.Eng., Ph.D., Student<sup>2</sup> and Louis Gosselin, P.Eng., Ph.D., S-B-a Member<sup>3</sup>, (1)Université Laval, Québec, QC, Canada, (2)Université Laval, Québec City, QC, Canada, (3)Université Laval, Québec city, QC, Canada*

9:30 AM - 10:30 AM

**Paper Session 25**

**Radon, Carbon Monoxide and Humidity Control**

*Room: Ravel*

*Chair:*

**1. Investigation of the Thermal Conditions and Wood Decay in Wooden Hot Spring Facilities**

*Aakriti Shrestha<sup>1</sup>, Takashi Ono<sup>1</sup>, Yugo Matsuzaki<sup>2</sup>, Thomas Weiser<sup>1</sup> and Takafumi Shimizu<sup>3</sup>, (1)Shimane University, Matsue, Japan, (2)Sumitomo Forestry Homotech co., Tokyo, Japan, (3)Shimane University, Matsue, Japan*

**2. Impact of Energy Retrofits on Indoor Radon in Townhouses in Canada**

*Janet Gaskin<sup>1</sup>, Liang Grace Zhou<sup>1</sup>, Yunyi Ethan Li<sup>1</sup> and Peter Amerongen<sup>2</sup>, (1)National Research Council Canada, Ottawa, ON, Canada, (2)Renu Engineering Inc, Edmonton, AB, Canada*

**3. Good News And Bad News About Carbon Monoxide**  
*Albert Donnay, Donnay Detoxicology LLC, Hyattsville, MD*

Friday, September 26, 11:00 AM - 12:30 PM

### Paper Session 26

## Occupancy Behavior in Commercial / Institutional Buildings

*Room: Concerto*

*Chair:*

**1. The Role and Importance of Human Presence and Interactions on the Quality and Effectiveness of Care Processes That Take Place in Indoor Environments in Healthcare Facilities During a Pandemic**

*Karin Kompatscher, Anneloes de Lange and Norman Egter van Wissekerke, Dutch Organization for Applied Scientific Research (TNO), Delft, Netherlands*

**2. An Occupant-Centric Control Framework For HVAC Systems In Educational Buildings**

*Quinten Carton<sup>1</sup>, Jakub Kolarik<sup>2</sup> and Hilde Breesch<sup>1</sup>, (1)KU Leuven, Gent, Belgium, (2)DTU, Copenhagen, Denmark*

**3. A Design Thinking Initiative Towards Studying Classroom Indoor Climate**

*Asit Kumar Mishra<sup>1</sup>, Pawel Wargocki, Dr., Fellow Member<sup>2</sup> and Eilis O'Reilly<sup>1</sup>, (1)University College Cork, Cork, Ireland, (2)DTU, Kongens Lyngby, Denmark*

**4. Towards Occupant-Centric Demand Response: Integrating Occupant Behaviour for Enhanced Peak Demand Management**

*Zeinab Khorasani zadeh, Student<sup>1</sup>, Mohamed Ouf, Associate<sup>1</sup>, Burak Gunay<sup>2</sup>, Benoit Delcroix, Ph.D.<sup>3</sup> and Gilbert Larochellemartin<sup>3</sup>, (1)Concordia University, Montreal, QC, Canada, (2)Carleton University, Ottawa, ON, Canada, (3)Hydro-Québec Research Institute, Varennes, QC, Canada*

**5. On the Use of Heating and Lighting Personalised Comfort Systems to Reduce Electricity Uses and Improve Comfort Conditions in Office Buildings. A Field Study.**

*Martina Botticelli<sup>1</sup>, Iliaria Pigliautile<sup>2</sup> and Michele Zinzi, PhD<sup>3</sup>, (1)Italian National Agency for New Technologies, Rome, Italy, (2)eCampus University, Novedrate, Italy, (3)ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Rome, Italy*

11:00 AM - 12:30 PM

### Paper Session 27

## Thermal Resilience and Standards

*Room: Ravel*

*Chair:*

**1. The Evolution of Walloon Thermal Standards: A Comprehensive Assessment Across Climate Scenarios**

*Pauline Abrahams and Philippe André, Université de Liège, Arlon, Belgium*

**2. Evaluating Overheating Metrics and Passive Cooling Strategies for Thermal Resilience in Multi-Unit Residential Buildings During Extreme Heat**

*Kehinde Bayode, Joyce Kim, Full Member, Jim Ji and Jeffery Li, University of Waterloo, Kitchener, ON, Canada*

**3. Applicability Of Overheating Analysis Approaches For Big Indoor Temperature Monitoring Data**

*Mats Persson, Despoina Teli and Nora Speicher, Chalmers University of Technology, Gotehenburg, Sweden*

**4. Enhancing Thermal Resilience with Increased Tree Canopy Coverage: A Case Study in a Canadian Neighborhood**

*Lili Ji, Abhishek Gaur, Abdelaziz Laouadi, Zahra Jandaghian, PhD, Member and Adam Wills, National Research Council Canada, Ottawa, ON, Canada*

**5. Assessing Swac (Sea Water Air Conditioning) as a Resilient Air Conditioning Technology in a Global Warming Context**

*Perceval Raybaud<sup>1</sup>, Kanhan Sanjiv<sup>1</sup>, Olivier Marc<sup>2</sup> and Franck Lucas<sup>1</sup>, (1)Université de la Polynésie Française, Puna'auia, French Polynesia, (2)Univeristy of Reunion Island, Saint Denis, France*

11:00 AM - 12:30 PM

### Paper Session 28

## Thermal Comfort and Building Subsystems

*Room: Tchaikovsky*

Chair:

**1. Performance Verification of Task/Ambient Air-conditioning System with Variable Air Supply Direction**

*Airi Esaki, Student Member<sup>1</sup>, Takashi Akimoto<sup>2</sup>, Keizo Yokoyama<sup>2</sup>, Yu Sakamoto, Associate<sup>3</sup>, Kazuki Yajima<sup>3</sup>, Atsushi Yanagisawa<sup>3</sup> and Nobuhiro Hirasuga, Eng. Associate<sup>4</sup>, (1)Shibaura Institute of Technology, Tokyo, Japan, Japan, (2)Shibaura Institute of Technology, Tokyo, Japan, (3)Shinryo Corporation, Tokyo, Japan, (4)Mitsubishi Jisho Design Inc., Tokyo, Japan*

**2. Indoor Environmental Quality in Split Air-Conditioned Classroom: An Experimental Study on Air Quality and Thermal Comfort in a Warm-Humid Climate**

*Ajith N Nair<sup>1</sup>, Prashant Anand<sup>1</sup> and Ardeshir Mahdavi, Professor<sup>2</sup>, (1)IIT KHARAGPUR, Alappuzha, India, (2)Graz University of Technology, Graz, Austria*

**3. Enhancing Indoor Environmental Quality (IEQ) with Water in Mind: The Important Role of Hydronic-Based Hybrid HVAC Systems with Domestic Water Heat-Interface Units for Enabling Healthier Environments.**

*Robert Bean, Fellow Member<sup>1</sup>, Hailey N Mick, Full Member<sup>2</sup> and Kevin Wong<sup>3</sup>, (1)Retired, Chestermere, AB, Canada, (2)Uponor, Quispamsis, NB, Canada, (3)GF Building Flow Solutions Americas, Apple Valley, MN*

**4. Quantifying Window Airtightness for Energy Efficiency and Occupant Comfort**

*Violette Labrousche<sup>1</sup> and Martin Prignon<sup>2</sup>, (1)Buildwise, Brussel, Belgium, (2)Buildwise, Zaventem, Belgium*

**5. Thermal Comfort Evaluation of a Novel Ventilation Strategy for Affordable Double-Loaded Apartment Buildings in the Full-Scale Experimental House**

*Tetsu Kubota<sup>1</sup>, Nikhil Kumar<sup>2</sup>, Hanief Sani<sup>1</sup> and Muhammad Nur Fajri Alfata<sup>3</sup>, (1)Hiroshima University, Higashi-Hiroshima, Hiroshima, Japan, (2)Indian Institute of Technology Varanasi, Uttar Pradesh, India, (3)Ministry of Public Works, Jakarta, Indonesia*

11:00 AM - 12:30 PM

**Workshop 9 (Intermediate)**

**Bedroom Environmental Quality Impacts our Sleep, Health and Well-being**

Room: Opus Ballroom

Chair: Chandra Sekhar, PhD, Fellow Member, National University of Singapore, Singapore, Singapore

Sleep is an integral part of human life and the importance and significance of good Bedroom Environmental Quality (BEQ) and Sleep Quality cannot be emphasized more. When compared with research findings on IEQ and its impact on human comfort, health and well-being during our awake state in different types of buildings and transportation environments, there is a paucity of such information in the scientific literature pertaining to similar impacts in sleeping environments. We spend more than 90% of our time indoors and sleep for about a third of our lives in sleeping environments. Are our bedrooms adequately ventilated at all times to maintain good IAQ? Is the thermal comfort of our bedroom acceptable across all seasons? Is our bedroom environmental quality affecting our sleep quality, and thereby our health and well-being? Are we even aware of these associations? What do the various international standards say about thermal comfort, IAQ, visual and acoustic aspects of our sleeping environments? A workshop on this topic included some of the above questions and was presented as a webinar on 12 January 2023, which was organised by ASHRAE and AIVC. There has been a growing international interest on this subject within the last 5 years that has resulted in many new top peer-reviewed journal publications. This Workshop at IEQ 2025 in Montreal aims to continue the ongoing discussions about BEQ and Sleep Quality by incorporating the current state-of-the-art research, new knowledge gained and call-to-action for enhanced ventilation and IEQ standards in sleeping environments.

**1. Workshop Introduction**

*Chandra Sekhar, PhD, Fellow Member, National University of Singapore, Singapore, Singapore*

**2. Ventilation and Sleep Quality: The Need for Changing Residential Standards**

*Pawel Wargocki, Dr., Fellow Member, Technical University of Denmark, Lyngby, Denmark*

**3. Sleep Quality and Skin Temperature Variation Using a Thermal Regulatory Mat**

*Hyeun Moon, Dankook University, Yongin, South Korea*

**4. Methods for Measurements of Sleep Quality: The Sleep Researcher Perspective**

*Guido Simonelli, University de Montreal, Montreal, Quebec, Canada*