



ASHRAE VIRTUAL WINTER CONFERENCE

▶▶▶ February 9-11, 2021

TECHNICAL PROGRAM

Tuesday, February 9

Tuesday, February 9, 10:30 AM - 11:30 AM

Seminar 1 (Intermediate)

What's in your Toolkit? Laboratory Efficiency for Cutting Edge Labs (Live Presentations)

Track: Energy Conservation

Sponsor: 9.10 Laboratory Systems

Chair: Jason Atkisson, P.E., Member, Affiliated Engineers, Inc., Madison, WI

Cutting-edge research often hosts hazards that must be contained effectively to maintain a safe work environment for researchers. As a result, laboratories are complex buildings that can be challenging and costly to operate correctly, typically consuming up to ten times more energy than similar-sized commercial buildings. To guide stakeholders in research facilities to enhance energy efficiency and safety of indoor environments in new or existing laboratories, the Smart Labs Toolkit, the application of risk-based ventilation and an example program with best practices is presented.

1. Smart Labs Toolkit: A Guide to Enable Labs of the Future

Rachel Romero, P.E., Member, National Renewable Energy Laboratory, Golden, CO

2. How Occupant Demand for Ventilation Drives Safety and Efficiency in Smart Labs

Thomas Smith, Member, 3Flow, Cary, NC

3. Argonne's Journey to Smart Labs: Integrating Safety, Sustainability and Operations

Catherine Hurley, P.E., Argonne National Laboratory, Lemont, IL

Tuesday, February 9, 12:00 PM - 1:20 PM

Seminar 2 (Intermediate)

Air Cleaning for the Indoor Air Quality Procedure **LIVE Q&A**

Track: Standards, Guidelines and Codes

Sponsor: SSPC 62.1

Chair: Michael Sherber, P.E., Member, Plasma Air International, Inc., Stamford, CT

Four separate air cleaning technologies are discussed as ways to comply with the Indoor Air Quality Procedure of Standard 62.1-2019.

1. Air Filtration Applications for Std. 62.1 Indoor Air Quality Procedure

Charles Seyffer, Life Member, retired, Troy, NY

2. UVC Applications for Air Cleaning

Ashish Mathur, Ph.D., Member, UVDI, Valencia, CA

3. Application of Air Cleaners in Std. 62.1-2019

Joe Pessa, Associate Member, Dynamic Air Quality Solutions, Princeton, NJ

4. Controlling Outdoor and Indoor Chemical Contaminants Using Adsorbents and Chemisorbents

Chris Muller, Member, Muller Consulting, Atlanta, GA

12:00 PM - 1:20 PM

Seminar 3 (Intermediate)

Lessons from Managing Infrastructure through the COVID Shutdown **LIVE Q&A**

Track: Building Performance and Commissioning for Operation and Management

Sponsor: 7.3 Operation and Maintenance Management

Chair: Matthew Mullen, P.E., Member, EMCOR Services New England Mechanical, South Windsor, CT

COVID-19 changed campus infrastructure management completely... or did it? In this session, campus infrastructure managers share their experiences with the shutdown and reopening at their campuses. Topics will include: Team management for remote work; designating essential workers and maintenance tasks; system turn-back; increased patrols in empty buildings; reliance on Building Automation; technical aspects and retrofits; accommodations for reopening; and yes, watering potted plants.

1. Managing the COVID Campus: Stories from the Empty Halls

Orvil Dillenbeck, P.Eng., Member, Canadian Nuclear Laboratories, Chalk River, ON, Canada

2. Do's and Don'ts of Reopening

Aaron Sorrell, Member, General Services Administration (GSA), Boston, MA

3. Large University Campus Faces Difficult Decisions

David Norvell, P.E., BCxP, Member, University of Central Florida, Orlando, FL

12:00 PM - 1:20 PM

Seminar 4 (Intermediate)

Limiting Humidity to Reduce Building Dampness Health Risks **LIVE Q&A**

Track: HVAC&R Fundamentals and Applications

Sponsor: SSPC 62.1

Chair: Elliott Horner, Ph.D., Member, UL Environment, Marietta, GA

ASHRAE's 2019-2024 Strategic Plan extends 80% occupant satisfaction to include a healthy built environment. Excessive indoor moisture has long caused structural and material damage, and increased occupant health risks. In ASHRAE Standard 62.1:2019 (Ventilation for Acceptable IAQ) the humidity limit is a maximum dew point temperature of 15°C (60°F) rather than 65% RH (without reference to any dry bulb temperature). This requires mechanically cooled spaces to have dehumidification components/controls that limit humidity (occupied and unoccupied hours) when outdoor dew point exceeds 60°F (15°C). This impacts systems design and operation to preserve IAQ and prevent damage to building materials.

1. The Health Argument for Sufficient Management of Moisture in Buildings

Carl Grimes, HHS, CIEC, Hayward Healthy Home, Monterey, CA

2. Why the Maximum Humidity Limit Changed from Relative to Absolute (60°F Dew Point) in Std 62.1-2019

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

3. Design Requirements and System Changes to Deal with the Shift to Dew Point

Brian Hafendorfer, P.E., Member, Gray Engineering, Lexington, KY

12:00 PM - 1:20 PM

Seminar 5 (Basic)

Refrigeration System Design Considerations **LIVE Q&A**

Track: Refrigeration and Refrigerants

Sponsor: 10.1 Custom Engineered Refrigeration Systems

Chair: Tom Wolgamot, P.E., Member, DC Engineering, Missoula, MT

This seminar covers relevant topics for the engineer new to the Refrigeration Industry. It starts with a session describing lessons learned from a design and safety perspective. The second session progresses and provides insights into the various valve types utilized in a refrigeration system and their purposes. The final session provides guidance on the selection of valves used within Transcritical CO2 systems.

1. Lessons Learned from Refrigeration System Failures

Greg Scrivener, Member, Cold Dynamics, Meadow Lake, SK, Canada

2. Industrial Refrigeration Valves

Adnan Ayub, P.E., Member, Isotherm, Inc., Arlington, TX

3. Transcritical CO2 Booster System Operation and Valve Selections

Jeff Newel, Hill Phoenix, Conyers, GA

Tuesday, February 9, 1:30 PM - 2:30 PM

Seminar 6 (Basic)

Fighting the Unseen Killers: Gas-Phase Air Cleaners (Live Presentations)

Track: HVAC&R Fundamentals and Applications

Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Kyung-Ju Choi, Ph.D., Member, Clean & Science, Louisville, KY

Gaseous contaminants such as formaldehyde, radon, odor, COx, NOx, SOx, O3, VOCs, SVOCs damage the environment and human health. Filtration has a critical role in mitigating such damage. This seminar explains how gas-phase air cleaners work in filtering harmful contaminants.

1. How Do I Get Rid of All That Stuff in My Air?

Matt Middlebrooks, Filtration Group, Dallas, TX

2. What's in My Air? Can My Air Cleaner Help Me?

Kathleen Owen, Fellow ASHRAE, Owen Air Filtration Consulting, Cary, NC

3. What Is in My Gas Phase Filter and Why?

Paula Levasseur, Member, Cameron Great Lakes, Portland, OR

Tuesday, February 9, 3:00 PM - 4:20 PM

Seminar 7 (Basic)

Building the Next Generation in Building Science: The Solar Decathlon Competition LIVE

Q&A

Track: Energy Conservation

Room: Virtual

Sponsor: YEA and Student Activities

Chair: Jonathan Smith, Member, Siemens, Kansas City, MO

The U.S. Department of Energy Solar Decathlon is a collegiate competition that challenges student teams to design high performance buildings that push the boundaries of the industry. Over 20 years, the program and the competitors have learned to execute on teaching building science to students with teams showing their progress. Split into Design Challenge and Build Challenge, the competition values innovative approaches for scaled adoption of high-performance design, energy efficiency, energy production and grid integration, as well as overall functionality and appeal. Attendees learn best practices and also how to create successful teams to meet challenging, realistic goals.

1. Changing the Industry through Team Development in the Competition

Rachel Romero, P.E., Member, National Renewable Energy Laboratory, Golden, CO

2. Better Buildings through Better Training and Education

Paul Torcellini, Ph.D., P.E., Fellow ASHRAE, National Renewable Energy Laboratory, Golden, CO

3. Integrated Design Strategies for High-Performance Zero Energy Buildings: Case Studies of Student Projects

Edoarda Corradi Dell'Acqua, Illinois Institute of Technology, Chicago, IL

3:00 PM - 4:20 PM

Seminar 8 (Intermediate)

Lubricant Properties and Their Lubrication in Compressors with Low GWP Refrigerants

LIVE Q&A

Track: Refrigeration and Refrigerants

Room: Virtual

Sponsor: 3.4 Lubrication

Chair: Kristin Sullivan, P.E., Member, Trane Technologies, La Crosse, WI

In recent years, identification of low GWP refrigerants has intensified due to environmental concerns. The refrigerant transitions involve technical challenges related to lubricant selection. Deploying a new refrigerant into an existing system requires close scrutiny due to several interconnected parameters. Those parameters include system chemistry and properties related to the wear between moving surfaces, which directly relate to the reliability and durability of compressor systems. This seminar covers the

history of refrigerants and lubricants, a review of the process for matching refrigerants and lubricants, and a case study on wear performance of R410A alternatives in a compressor system.

1. The Lubricant and Low GWP Refrigerant Match Game

Joe Karnaz, DSc, Member, Shrieve Chemical, Houston, TX

2. Lubricant Optimization for HFO/HFC Blends Compared to CFC/HCFC Refrigerants

Andrew Sumner, Associate Member, CPI Fluid Engineering, Midland, MI

3. Influence of Refrigerant/Lubricant on Compressor's Wear Performance

Wasim Akram, Ph.D., Associate Member, Trane Technologies, Minneapolis, MN

3:00 PM - 4:20 PM

Seminar 9 (Intermediate)

Mass Transit Ventilation and Infectious Diseases – Transmission and Countermeasures

LIVE Q&A

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 9.3 Transportation Air Conditioning

Chair: Gursaran Mathur, Marelli North America, Farmington Hills, MI

Vehicles instrument panel surface can become contaminated by the front occupants by breathing, talking and coughing. Air conditioning vent outlet airflow will pull air from the panel surface mixing it with potential contaminated air and deliver towards the occupants. Hence, it is necessary to ensure we have virus mitigating strategies to effectively remove viruses from the cabin from automobiles. This seminar consists of technical presentations outlining how the viruses spread in automotive and aircraft cabins using CFD analysis, experimental studies with new hardware designs to eliminate viruses from the automotive cabin; ASHRAE guidelines to address Covid-19.

1. COVID-19 Transmission Risk Reduction through Social Distanced Seating in Aircraft Cabins

James Bennett, Ph.D., Member, CDC/NIOSH, Cincinnati, OH

2. Recommendations to Minimize the Risk of COVID-19 Spread in Marine Applications

Augusto SanCristobal, Bronswerk Group, Montreal, QC, Canada

3. Elimination of Viruses from Automobile Cabins

Gursaran Mathur, Marelli North America, Farmington Hills, MI

4. ASHRAE's COVID-19 Guidance Document for Mass Transit

Donald LeBlanc, National Research Council of Canada, Ottawa, ON, Canada

Tuesday, February 9, 4:30 PM - 5:30 PM

Forum 1 (Intermediate)

Advanced Energy Design Guides: Zero Energy and Beyond, What is Next? (Live Presentation)

Track: Energy Conservation

Room: Virtual

Sponsor: 7.6 Building Energy Performance, Advanced Energy Design Guides Steering Committee

Chair: Thomas Phoenix, P.E., Presidential Fellow ASHRAE, CPL Architects & Engineers, PC, Greensboro, NC

The AEDG Steering Committee is looking for input on the current series of zero energy design guides as well as input on what sort of guides the Steering Committee should produce in the future. Possible future topics could include: grid integrated buildings, applying zero energy to existing buildings, building types not currently covered in existing 50% and zero energy series. Representatives from the Steering Committee's four partnering organizations (AIA, ASHRAE, IES, and USGBC) welcome feedback on what efforts would provide the most benefit to moving the industry and buildings towards a more sustainable future.

4:30 PM - 5:30 PM

Forum 2 (Intermediate)

Feedback from the Public on Current Decarbonization Pathways (Live Presentation)

Track: Energy Conservation

Room: Virtual

Sponsor: 6.10 Fuels and Combustion, 1821

Chair: Thomas Neill, Member, Mestek Inc, Southampton, MA

The objective of this forum is to solicit ASHRAE community feedback and to facilitate open discussion regarding decarbonization and greenhouse gas (GHG) emission reduction pathways for the built environment. The discussion is focused on, but not limited to, building energy efficiency, on-site and off-site renewable energy generation and electric and thermal energy storage, electrification, GHG-neutral energy consumption, the role of renewable fuels, building occupant comfort, policy targets for reductions in greenhouse emissions, theoretical vs applied concepts and costs.

6:00 PM - 7:50 PM

Seminar 10 (Intermediate)

Standardizing High Performance: Guideline 36 and Beyond **LIVE Q&A**

Track: Standards, Guidelines and Codes

Room: Virtual

Sponsor: 1.4 Control Theory and Application

Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

What if it were possible for every new or retrofitted building to exit the construction process performing optimally? What if installing a building automation system were synonymous with achieving high performance? Guideline 36 is a step in that direction, but early implementation has highlighted some challenges in achieving the vision of high performance for all. In this program, the speakers will discuss some of these challenges, as well as additional work underway to streamline the process of designing, evaluating, implementing, testing, and deploying high performance sequences of operation on the journey to make high performance accessible to every project everywhere.

1. Guideline 36: The Journey to Success!

Hwakong Cheng, P.E., Member, Taylor Engineering LLP, Tacoma, WA

2. How Speaking the Same (Computer-Interpretable) Language Helps

Michael Wetter, Ph.D., Member, Lawrence Berkeley Lab, Berkeley, CA

3. A Standard for That: ASHRAE 231P, Control Description Language

Paul Ehrlich, P.E., Member, Building Intelligence Group, Portland, OR

4. Better Together: Co-Design for the Win!

Veronica Adetola, PNNL, Richland, WA

6:00 PM - 7:50 PM

Seminar 11 (Intermediate)

Techno-Economic Comparison of Energy Storage Technologies **LIVE Q&A**

Track: Systems and Equipment

Room: Virtual

Sponsor: 6.9 Thermal Storage, 7.5 Smart Building Systems

Chair: Kyle Gluesenkamp, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Energy storage can improve building resilience and efficiency, reduce energy costs, and reduce grid infrastructure expenditures. In this seminar, we present findings from ongoing research into the performance and affordability of various energy storage strategies. We compare and contrast the technical and economic benefits of several thermal energy storage strategies with electrochemical energy storage technologies (batteries). We provide guidance on design strategies for buildings and systems that incorporate energy storage, present annual simulation results, highlight unique benefits of competing technologies, provide insight into the future trajectory of costs and capabilities, and offer a framework for future research and innovation.

1. Opportunity for Thermal Storage to Provide Grid Flexibility Today and in the Future

Chuck Booten, Ph.D., National Renewable Energy Laboratory, Golden, CO

2. Comparing the Economic Performance of Ice Storage and Batteries for Buildings with on-Site PV

Jim Braun, Ph.D., P.E., Fellow ASHRAE, Concordia University, Montreal, QC, Canada

3. Novel Residential Heating and Cooling System Design Using Thermal Storage to Reduce Home Owners Operating Cost Using Time-of-Day Rates

Mike Kazmierczak, Ph.D., Member, University of Cincinnati, Cincinnati, OH

4. Phase Change Materials and Batteries for Energy Storage in Small HVAC Systems – Design Considerations and Life Cycle Cost Comparisons

Jonathan Woolley, Lawrence Berkeley National Laboratory, Berkeley, CA

Wednesday, February 10

Wednesday, February 10, 7:00 AM - 8:50 AM

Seminar 12 (Intermediate)

Thermal Storage for Grid-Friendly Refrigeration **LIVE Q&A**

Track: Refrigeration and Refrigerants

Room: Virtual

Sponsor: 6.9 Thermal Storage

Chair: Scott Hackel, P.E., Member, Slipstream, Madison, WI

Refrigeration systems not only use a tremendous amount of energy but can also be a significant stress on the grid as they tend to be operating near full-load at peak times. Thermal storage, which has been a well-proven approach to shifting load in HVAC systems, can also be applied to refrigeration systems to provide cost-effective grid services like demand response, load shifting, and load shaping. There are a few different technologies and methods for refrigeration thermal storage. This seminar will cover practices for each based on some of the latest research in the industry.

1. Options for Thermal Energy Storage in Refrigeration

Greg Marsicek Jr., P.E., Associate Member, Slipstream, Madison, WI

2. Minimizing Energy Cost in Refrigerated Warehouses with Storage: An Owner's Story

Woolf Alex, Lineage Logistics, San Francisco, CA

3. Field Testing of Commercial Refrigeration Cases for Demand Response

Michael Deru, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO, USA, Golden, CO

4. Using Phase Change Material to Add Efficiency, Flexibility, and Resiliency to Refrigeration Systems

Brad North, P.E., Viking Cold, Houston, TX

7:00 AM - 8:50 AM

Seminar 13 (Intermediate)

What Have You Done for Me Lately? BAS Best Practices for O&M Success **LIVE Q&A**

Track: Building Performance and Commissioning for Operation and Management

Room: Virtual

Sponsor: 1.4 Control Theory and Application

Chair: Charlotte Dean, P.E., Affiliate, P2S Inc., Long Beach, CA

What is the role of Operations and Maintenance in the design, specification and delivery of a building automation system project? The speakers share examples of how to incorporate O&M staff and operational considerations into the design, specification and successful implementation of a BAS project from the perspective of a building owner, system integrator, specifier/consultant and controls vendor.

1. Where the Rubber Meets the Road: An Owner's Perspective

Paul Valente, Chicago Public Schools, Chicago, IL

2. Using Data to Drive Action: A System Integrator's Perspective

Scott Donovan, Automated Logic, Kennesaw, GA

3. Reserve Your Seat at the Table! – a Guide to Operations and Maintenance's Role in the Design, Specification, and Delivery of Your Building Automation System.

Ron Bernstein, Member, RBCG Consulting, San Diego, CA

4. How a Cloud Connected Building Ensures Operational Excellence and Occupant Satisfaction

Joel Desire, Distech Controls, Montreal, QC, Canada

10:30 AM - 11:30 AM

Seminar 14 (Basic)

What You Need to Know About ANSI/ASHRAE Standard 90.4: *The Energy Standard for Data Centers* (**Live Presentation**)

Track: Standards, Guidelines and Codes

Room: Virtual

Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment, SSPC 90.4, SSPC 90.1

Chair: Robert McFarlane, Member, Shen Milsom & Wilke, LLC, New York, OR

The 2019 version of Standard 90.4 was officially recognized in Standard 90.1 as the Alternate Compliance Path for Data Centers, defined as greater than 10 kW and 20 W/sf power density. Smaller facilities are defined as Computer Rooms and remain governed by Std. 90.1. Standard 90.4 has already been adopted in the state of Washington and is pending adoption in other jurisdictions. It will be widely recognized as Std. 90.1-2019 is adopted, so it is important that designers understand its substantial differences from 90.1 and the advantages it offers for achieving compliance in Mission Critical Data Center designs.

1. The Origin of ANSI/ASHRAE Std. 90.4, Its Purpose and Format and Using the Electrical Loss Component (ELC) Metric

Robert McFarlane, Member, Shen Milsom & Wilke, LLC, New York, OR

2. Understanding the Mechanical Load Component (MLC) and Tradeoff Options in ANSI/ASHRAE Std. 90.4

Vali Sorell, P.E., Member, Microsoft Corporation, Charlotte, NC

3. The Relationship between Standards 90.1 and 90.4, and the Importance of 90.4 to Mission Critical Facilities

Timothy Peglow, P.E., Member, MD Anderson, Houston, TX

Wednesday, February 10, 12:00 PM - 1:00 PM

Debate 1 (Intermediate)

Is Air Change per Hour (h^{-1}), cfm/ft² or Something Else? (Live Presentation)

Track: HVAC&R Fundamentals and Applications

Room: Virtual

Sponsor: MTG.ACR, 9.11 Clean Spaces, TC9.6, TC 9.10, and EHC

Chair: Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI, James Bennett, Ph.D., Member, CDC/NIOSH, Cincinnati, OH, Joe Zulovich, Ph.D., P.E., Affiliate, University of Missouri, Columbia, MO, Travis English, P.E., Member, Kaiser Permanente, Anaheim, CA and Dan Koenigshofer, P.E., Member, Dewberry, Chapel Hill, NC

Ventilation airflow requirements are specified in standards, codes and design guidelines in terms of Air changes per hour (h^{-1}), cfm/ft², cfm/person, etc. Quantity of supply airflow rate depends on such specification. A group of people who support air change rate thinks it has been working successfully from several decades in making the critical spaces safe, comfortable and healthy. Another group thinks this legacy practice has a little scientific basis and is a burden on energy efficiency and cost of operation of HVAC systems. This session is an open debate on this issue. Active participation is required from the attendees.

Wednesday, February 10, 1:30 PM - 2:50 PM

Seminar 15 (Intermediate)

**Building Operation and COVID-19: What is the Standard of Care and Who's Responsible
LIVE Q&A**

Track: Building Performance and Commissioning for Operation and Management

Room: Virtual

Sponsor: 7.3 Operation and Maintenance Management

Chair: Matthew Mullen, P.E., Member, EMCOR Services New England Mechanical, South Windsor, CT

The COVID-19 Pandemic has dramatically impacted how buildings are used and operated in order to secure occupant health. ASHRAE and many other organizations have published guidance for how to operate buildings. Each building is unique and implementing the guidance is not always uniform. So what is the minimum Standard of Care building owners, operators and occupants be accountable to? And what responsibility does each have in implementing the minimum Standard of Care? This seminar features an owner, operator and lawyer providing their perspective and answers on this crucial topic.

1. The Legal Perspective

Mitchell Swann, P.E., Resolution Management Consultants, Marlton, NJ

2. The Operator's Perspective

Matthew Mullen, P.E., BEAP, Member, EMCOR Services New England Mechanical, South Windsor, CT

3. The Owner's Perspective

Speaker TBDetermined, Unknown Property Owner, Chicago, IL

1:30 PM - 2:50 PM

Seminar 16 (Intermediate)

Dedicated Outdoor Air Systems: Applications, Specification and Commissioning **LIVE Q&A**

Track: Systems and Equipment

Room: Virtual

Sponsor: 8.10 Mechanical Dehumidification Equipment and Heat Pipes, 8.12 Desiccant Dehumidification Equipment and Components

Chair: Onieluan Tamunobere, Ph.D., P.E., Associate Member, Heat Pipe Technology, Tampa, FL

Dedicated Outdoor Air Systems (DOAS) continue to pose industry-wide challenges to specifying and design engineers as well as commissioning agents. In the last three years, the industry has introduced new efficiency metrics such as the Integrated Seasonal Moisture Removal Efficiency (ISMRE), testing procedures (ASHRAE 198), a design guide as well as updates to all accompanying standards. This seminar reviews applications for Dedicated Outdoor Air Systems (DOAS); how specifying engineers go about specifying this equipment and finally, best practices in commissioning Dedicated Outdoor Air Systems (DOAS).

1. Applications in Dedicated Outdoor Air Systems (DOAS)

Craig Burg, Member, Desert Aire Corp, Germantown, WI

2. Specifying Dedicated Outdoor Air Systems (DOAS)

Randy Schrecengost, P.E., BEAP, Member, Stanley Consultants, Austin, TX

3. Commissioning Dedicated Outdoor Air Systems (DOAS)

Gayle Davis, P.E., Member, Stanley Consultants, Leander, TX

1:30 PM - 2:50 PM

Seminar 17 (Intermediate)

Hotter Cities, Hotter Climates: Modelling and Measuring Urban Heat Island Effects Around the World **LIVE Q&A**

Track: International Design

Room: Virtual

Sponsor: 4.2 Climatic Information

Chair: Ralph Muehleisen, Ph.D., P.E., Member, Argonne National Laboratory, Lemont, IL

Mitigating Urban Heat Island (UHI) or urbanisation-related weather issues is of critical importance for millions of urban dwellers worldwide. It affects building energy consumption and outdoor comfort and has been associated with increased morbidity and mortality and worsening air quality. This makes quantifying these effects a priority for researchers and practitioners alike. This seminar presents (1) a review of the numerical modelling of urban heat island mitigation, and (2) a case study of blue and green mitigation of urban canyons based on measurements. The speakers discuss possible mitigation approaches to the problems highlighted.

1. Cooling Hot Cities: A Systematic and Critical Review of the Numerical Modelling Literature

Evyatar Erell, Ph.D., Ben-Gurion University of the Negev, Beersheba, Israel

2. Case Studies of Blue and Green Mitigation of Urban Canyons

Eric Peterson, Ph.D., P.E., University of Leeds, Leeds, United Kingdom

1:30 PM - 2:50 PM

Seminar 18 (Intermediate)

New Standard: ASHRAE 221 Overview **LIVE Q&A**

Track: Standards, Guidelines and Codes

Room: Virtual

Sponsor: 7.3 Operation and Maintenance Management

Chair: Matthew Mullen, P.E., Member, EMCOR Services New England Mechanical, South Windsor, CT

ASHRAE 221 - *Test Method to Field-Measure and Score the Cooling and Heating Performance of an Installed Unitary HVAC Systems*, provides a new and revealing method to score the performance and efficiency of an installed HVAC system in the field. The scores reveal the impact of inherent defects in installation, deferred maintenance and hidden installed system losses. This Standard is written for use by all field professionals including installing contractors, technicians, commissioning and facility personnel, balancers, designers and energy efficiency program participants.

1. Introduction and Description of ASHRAE 221

Rob Falke, Member, National Comfort Institute, Avon Lake, OH

2. 221 Testing and Calculations

Peter C. Jacobs, P.E., Member, BuildingMetrics, Incorporated, Boulder, CO

3. Uses of 221's Installed System Scores

Ben Lipscomb, P.E., Associate Member, National Comfort Institute, Whitefish, MT

Wednesday, February 10, 3:00 PM - 4:20 PM

Seminar 19 (Advanced)

ASHRAE HQ: From Conception to Reception LIVE Q&A

Track: Energy Conservation

Room: Virtual

Sponsor: 9.1 Large Building Air-Conditioning Systems

Chair: Dennis Wessel, P.E., Fellow Life Member, AIA, Atlanta, GA

The new ASHRAE Headquarters is a highly visible project that converted a 1970s vintage building into a Net Zero ready facility. This seminar takes the audience through the process from finding a suitable building, through completion of this highly visible project. During the course of the design of the project, the design team encountered many envelope and system challenges involving the remodel of an older building and the effort to renovate it to meet the requirements of current ASHRAE 90.1 energy goals, as well as the challenge of designing to a stringent list of owner project requirements.

1. Owner Requirements of Developing a Net Zero Project

Ginger Scoggins, P.E., Member, Engineered Designs, Cary, NC

2. ASHRAE HQ from an Architects Perspective

Gregory Walker, AIA, Houser Walker Architecture, Atlanta, GA

3. ASHRAE Headquarters

William "Stanton" Stafford, P.E., Member, Integral Group, Atlanta, GA

3:00 PM - 4:20 PM

Seminar 20 (Basic)

Idle Buildings are the Devil's Playground LIVE Q&A

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 1.12 Moisture Management in Buildings, 1.8 Mechanical Systems Insulation , 4.4 Building Materials and Building Envelope Performance

Chair: Diana Fisler, Ph.D., Member, ADL Ventures, Centennial, CO

Buildings operate as a system and perform in a comfortable, safe, and healthy way when well-designed and operated as designed. Sometimes buildings are idled or shut down without proper understanding that this can problems in the building envelope, water systems, and HVAC. Recently, we have experienced unprecedented times related to the pandemic. We saw universities close and reopen, vacated hospital wings and hotels closed while others had few guests. This seminar brings together experts from different areas of building performance to explain the consequences of such idling, and design concerns for idle buildings.

1. HVAC and Plumbing Systems: What Is the Correct Idle to Minimize Legionella and Other Indoor Environmental Quality Concerns during a Pandemic

Donald Snell, P.E., Associate Member, Liberty Building Forensics Group, Atlanta, GA

2. Design Conditions for CHW Pipe Insulation Systems to Account for Idle Building Syndrome

Gordon Hart, P.E., Member, Artek Engineering, LLC, Shrewsbury, MA

3. Idle Buildings, Accelerated Problems

Peter Adams, P.Eng., Member, Morrison Hershfield Ltd, Toronto, ON, Canada

3:00 PM - 4:20 PM

Seminar 21 (Intermediate)

Methods for Improving HVAC Efficiency Globally LIVE Q&A

Track: International Design

Room: Virtual

Sponsor: 8.11 Unitary and Room Air Conditioners and Heat Pumps

Chair: Chao Ding, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA

Residential and light commercial air conditioners are widely adopted in the world. Improving energy efficiency can save energy consumption, reduce emission, decrease consumer cost and improve energy security worldwide. Recent global high efficiency designs and best available technologies provide new opportunity to revise and strengthen the energy-efficiency standards and market transformation programs. In this seminar, three diverse, experienced researchers share their global experience and discuss methods for improving air conditioner energy efficiency.

1. Setting Long-Term Energy Efficiency Targets Based on Best Available Technology

Nihar Shah, Ph.D., P.E., Lawrence Berkeley National Laboratory, Berkeley, CA

2. Leapfrogging to Energy-Efficient and Climate-Friendly Air Conditioners – Model Regulation Guidelines

Brian Holuj, United Nations Environment Programme, Paris, France

3. Raising the Ceiling of Performance - the Global Cooling Prize

Iain Campbell, Rocky Mountain Institute, Boulder, CO

3:00 PM - 4:20 PM

Seminar 22 (Basic)

Your Ethics Toolbox: Building a Framework for Ethical Decision-Making With Case Studies **LIVE Q&A**

Track: HVAC&R Fundamentals and Applications

Room: Virtual

Sponsor: 1.7 Business, Management & General Legal Education

Chair: Mike Bilderbeck, P.E., Fellow ASHRAE, Pickering, Inc., Memphis, TN

ASHRAE members are often confronted with ethical issues (whether they realize it or not). This session is part of a continuing program under which ASHRAE members engage in an interactive session where participants are presented with multiple ethics cases, discuss the cases in small groups, and then reveal their decisions. Test your "Ethics IQ" against real cases and receive CE credit in the process.

1. Case Studies #1 and #2

Jennifer Leach, P.E., Member, United Energy Products, Baltimore, MD

2. Case Studies #3 and #4

Kristin Schaefer, P.E., Member, University of Houston, Houston, TX

3. Case Studies #5 and #6

Mike Bilderbeck, P.E., Fellow ASHRAE, Pickering, Inc., Memphis, TN

Wednesday, February 10, 6:00 PM - 7:50 PM

Seminar 23 (Intermediate)

Indoor Environment Modeling for Pandemic Resiliency **LIVE Q&A**

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 4.10 Indoor Environmental Modeling

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

COVID-19 has forced us to evaluate the role and ability of ventilation systems to protect people from airborne viruses. Given that a global health crisis seems to occur approximately every four years (such as SARS and H1N1), it now seems apparent that ventilation systems will need to actively contribute to resiliency of our society. In order to assess the benefits of ventilation systems, indoor environmental modeling can provide rapid testing of different options. The presentations in this seminar present different modeling options for different scenarios within ventilated spaces.

1. Airborne Infectious Disease Transmissions in Commercial Airplane Cabins

Qingyan Chen, Ph.D., Life Member, Purdue University, West Lafayette, IN

2. Quantifying the Benefit of Unoccupied Middle Seats on Commercial Flights for Airborne Virus Protection

Watts Dietrich, NIOSH, DC, DC

3. Quantification of Possibilities and Risks of Airborne Virus Exposure in Public Places By Indoor Fast Fluid Dynamics

Liangzhu Wang, Concordia University, Montréal, QC, Canada

4. A High Speed Assessment Tool of Mitigation Options to Control Pathogens in Air

Duncan Phillips, Ph.D., P.E., Associate Member, RWDI, Guelph, ON, Canada

5. Protecting Industrial Workers in a Pandemic

Duncan Phyfe, Associate Member, Alden Research Laboratory, Holden, MA

6:00 PM - 7:50 PM

Seminar 24 (Advanced)

Safe Transition to Flammable Refrigerants in Commercial Refrigeration Applications

LIVE Q&A

Track: Refrigeration and Refrigerants

Room: Virtual

Sponsor: 10.7 Commercial Food and Beverage Refrigeration Equipment

Chair: Gustavo Pottker, Ph.D., Member, Honeywell, Buffalo, NY

This seminar discusses several aspects related to the transition to flammable refrigerants in commercial refrigeration applications. Presenters will walk us through the latest developments in UL and IEC 60335-2-89 product safety standards, share experiences and potential mitigation strategies to deal with flammable refrigerants, as well as report on research activities related to refrigerant leak and ignition events.

1. A2L and A3 Refrigerants Testing for Reach-in Coolers

Xudong Wang, Ph.D., Member, Air-Conditioning, Heating and Refrigeration Technology Institute, Arlington, VA

2. Update on Standards Development - IEC 60335-2-89 Commercial Refrigeration

Brian Rodgers, Underwriters Laboratories, Northbrook, IL

3. Updates on UL 60335-2-89, the Standard for Commercial Refrigerating Appliances and UL 60335-2-40, the Standard for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers

Randall Haseman, UL LLC, Northbrook, IL

4. Use of Flammable Refrigerants from an Equipment Manufacturer's Perspective

Timothy Anderson, Hussmann, Bridgeton, MO

5. Refrigerant Charge Reduction to Mitigate Risks Associated with Flammable Refrigerants

Stefan Elbel, Ph.D., Member, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL

Thursday, February 11

Thursday, February 11, 7:00 AM - 8:50 AM

Seminar 25 (Intermediate)

Movement and Control of Airborne Pathogens with HVAC Systems LIVE Q&A

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 1.3 Heat Transfer and Fluid Flow, 9.6 Healthcare Facilities, MTG.ACR (Air Change Rate), TC 8.11 Unitary and Room air Conditioners and Heat Pumps

Chair: Pratik Deokar, Ph.D., Member, Rheem Manufacturing Company, Carrollton, TX

Airborne droplet and aerosols have been identified as contributors in transmission of various diseases like COVID-19. This seminar highlights case studies and CFD analysis of airflow patterns' impact on transmission of such airborne contaminants in buildings with higher air flow rates and ways to mitigate it. Also, it highlights the design and performance of a wind tunnel that helped in coronavirus aerosol collection for measurements and inactivation in lower air flow rates applications, such as in portable air purification systems. This seminar also describes pilot study of a novel PECO technology used to destroy airborne viruses in a hospital.

1. Impact of Airflow Patterns on Transmission of Airborne Contaminants

Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

2. Experimental Evaluation of Droplet Transmission through Building Air Handling System- a Case Study for COVID-19 Zonal Transmission

Kashif Nawaz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

3. Mid-Scale Wind Tunnel Testing of Residential Control Technology for Coronavirus Aerosol Collection and Inactivation

Christopher Hogan Jr., University of Minnesota, Minneapolis, MN

4. Indoor Airborne Transmission of COVID-19 Virus and the Role of Peco Technology to Reduce the Risk of Infection
D Goswami, Ph.D., P.E., Fellow ASHRAE, University of South Florida, Tampa, FL

7:00 AM - 8:50 AM

Seminar 26 (Intermediate)

Smarter Together: Integrating HVAC and Lighting Control LIVE Q&A

Track: Energy Conservation

Room: Virtual

Sponsor: 1.4 Control Theory and Application, TC 7.5

Chair: Scott Hackel, P.E., Member, Slipstream, Madison, WI

We may have finally reached a stage where lighting and HVAC control can work together, at multiple levels. The timing is good: as the low-hanging fruit of lighting and high-efficiency HVAC is exhausted, our industry increasingly turns to the intelligence of our buildings' controls. And lighting controls, which are increasingly networked broadly throughout a building, present an excellent source of intelligence for HVAC systems to tap into. This presentation describes a variety of integration approaches as well as a number of recent real-world experiences with the latest technology.

1. Power up Your Knowledge: Get Your Smart Buildings Superhero Card

Kandice Cohen, Affiliate, Trane, La Crosse, WI

2. Deeper Control Savings: Integrating HVAC with Networked Lighting

Scott Hackel, P.E., Member, Slipstream, Madison, WI

3. Integral Vs Integrated: The Story

Will Podgorski, Siemens, Buffalo Grove, IL

4. Research Aspects of Integration of Lighting and HVAC and Other Systems

Michael Myer, Member, Pacific Northwest National Laboratory, Richland, WA

Thursday, February 11, 10:00 AM - 11:30 AM

Seminar 27 (Intermediate)

MERV 13, HEPA and UVC: What Did Buildings Do During this Pandemic, and How to Make your Buildings More Resilient for the Next Outbreak (Live Presentations)

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 2.9 Ultraviolet Air and Surface Treatment, 2.10 Resilience and Security

Chair: Jason DeGraw, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

ASHRAE buildings have been implementing changes to their ventilation systems based on many different recommendations including the ASHRAE Position Document on Infectious Aerosols and the recommendations of the ASHRAE Epidemic Task Force. This seminar focuses on the two main strategies implemented by buildings: MERV13 Filtration & UVC (Ultraviolet Light) systems as recommended by the ASHRAE Position Document. The seminar also presents the current recommendations by the Chair of the ASHRAE Epidemic Task Force.

1. Why MERV 13 and NOT HEPA Filtration

Kathleen Owen, Fellow ASHRAE, Owen Air Filtration Consulting, Cary, NC

2. UVC: How to Do It: Design and Installation

Scott Sherwood, Member, Eco-Care Corporation, Bronx, NY

3. The Evolving State of COVID-19 HVAC Guidance: What Have We Learned, Where Are We Now, Where Are We Headed?

William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Penn State, University Park, PA

Thursday, February 11, 12:00 PM - 1:20 PM

Seminar 28 (Intermediate)

Ammonia and Other Natural Refrigerants Standards and Guidance LIVE Q&A

Track: Refrigeration and Refrigerants

Room: Virtual

Sponsor: 10.1 Custom Engineered Refrigeration Systems, Refrigeration Technology Committee

Chair: Tom Wolgamot, P.E., Member, DC Engineering, Missoula, MT

The primary refrigerant used in industrial refrigeration is ammonia because it has superlative efficiency, low cost, ease of use, and distinctive thermophysical characteristics. This seminar reviews the reasons for the use of natural refrigerants and the status of standards and other resources available to apply them safely and effectively.

1. Ammonia Standards and Research

Eric Smith, IIAR, Alexandria, VA

2. IIAR Publications

Eileen McKeown, IIAR, Alexandria, VA

12:00 PM - 1:20 PM

Seminar 29 (Basic)

Avoid the Headlines! Today's Top 10 Security Best Practices for Controls LIVE Q&A

Track: Building Performance and Commissioning for Operation and Management

Room: Virtual

Sponsor: 1.4 Control Theory and Application, 7.5 Smart Building Systems , 1.5 Computer Applications

Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

Is your controls system an attack vector a bad actor could use to compromise your building operation or company network? Or is it a secured, hardened asset or set of assets protecting your people and property? The truth is that it could be either, depending on how it was deployed, and whether security best practices were considered and are properly applied. Come learn the top 10 cybersecurity best practices that can be implemented today in nearly any commercial controls system to keep you out of the headlines!

1. User Accounts and Access Best Practices for Controls

Carol Lomonaco, Member, Johnson Controls, Milwaukee, WI

2. Controls Deployment Best Practices to Limit Exposure

Ken Gilbert, Automated Logic, Kennesaw, GA

12:00 PM - 1:20 PM

Seminar 30 (Basic)

Controls Standards, Guidelines and Codes: What YEA Need to Know! LIVE Q&A

Track: Standards, Guidelines and Codes

Room: Virtual

Sponsor: 1.4 Control Theory and Application, YEA

Chair: Omar Rojas, Member, Russell Sigler, Inc, Brea, CA

Controls can be daunting for the new and experienced engineers, yet they are a critical component of a building's design and becoming a well-rounded engineer. With so much information available on the matter, it's hard to know where to begin. This seminar provides an introduction to the guidelines, standards and codes to start you on path to becoming controls savvy. Start from the ground up learning the terms and concepts. Carry on through the standards and guidelines that will help you put concepts into practice. Reach a point where you can understand and prevent code control measures from under-performing.

1. An Introduction to Building Automation Controls and Communications: Learn to Speak the Language

Ron Bernstein, Member, RBCG Consulting, San Diego, CA

2. A Beginner's Trail through Guideline 36: Understanding How Control Sequences Can Influence System Design

James Del Monaco, P.E., Member, P2S Engineering, San Diego, CA

3. Control Measures in Energy Codes: Fantasy Versus Reality

Reid Hart, P.E., Member, Pacific Northwest National Laboratory, Richland, WA

12:00 PM - 1:20 PM

Seminar 31 (Intermediate)

Decouple, Optimize and Succeed with DOAS LIVE Q&A

Track: Systems and Equipment

Room: Virtual

Sponsor: 1.4 Control Theory and Application, 8.10 Mechanical Dehumidification Equipment and Heat Pipes

Chair: James Coogan, P.E., Associate Member, Siemens Smart Infrastructure, Chicago, IL

A new, multi-purpose building on an urban university campus is planned to significantly exceed the applicable energy efficiency code. The challenge calls for a design that meets diverse load conditions without waste and an on-line optimization function that

dynamically applies heating and cooling elements to best advantage. A Primary Dedicated Outdoor Air System was selected with hydronic heating and cooling fan powered terminals, to deliver comfort and ventilation but expend energy only where and when it's needed. The concept decouples ventilation from thermal conditioning and building pressurization. One talk explains the HVAC design and analysis; the other covers dynamic operation.

1. Applying DOAS with Secondary Heat and Cooling to Meet HVAC Challenges

Andrew Kozak, P.E., Member, Bard Rao + Athanas Consulting Engineers, New York, NY

2. Dynamically Optimizing a DOAS: Finding the Bottom

James Coogan, P.E., Associate Member, Siemens Smart Infrastructure, Chicago, IL

Thursday, February 11, 1:30 PM - 2:30 PM

Workshop 2 (Basic)

Best Practices of the Mentor-Mentee Relationship (Live Presentation)

Track: HVAC&R Fundamentals and Applications

Room: Virtual

Sponsor: YEA Committee, College of Fellows

Chair: Jessica Errett, P.E., Member, Energy Studio, Inc, Omaha, NE

Mentoring can be a powerful resource for personal and professional growth, not only for mentees, but for mentors as well. Are you working through a challenging new project or moving into a new role? ASHRAE members at any stage of their career will benefit from this interactive workshop. Mentorship does not just happen; it's important to be intentional about finding and nurturing relationships, both with those that fill experience gaps, but also with peers to achieve your highest potential. It's the goal of this workshop to organically connect members to develop their skills, knowledge and confidence to enhance attendees' growth.

1. Growth through Learning Inc.

Ralph Kison, Member, Growth Through Learning Inc., Vancouver, BC, Canada

Thursday, February 11, 3:00 PM - 4:20 PM

Seminar 32 (Intermediate)

Climate Control Solutions for What is Next, Moving from Hyperscale to The Edge LIVE Q&A

Track: HVAC&R Fundamentals and Applications

Room: Virtual

Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Chair: Herb Villa, Member, Rittal North America, Newark, NJ

IT is expanding from traditional data centers to very small, localized Edge deployments. Climate control must be able to support this migration. The move to The Edge is driven by the exponential growth of IoT. Supporting a variety of applications, Edge deployments support real time data collection and analysis, allowing near real time reaction to shifting market demands.

Employing the same core components (enclosures, power, security), the unique demands at The Edge warrant a renewed review all systems, with this seminar focusing on adapting climate control solutions from the hyperscale arena for use in the Edge space.

1. Climate Control Solutions for What's Next

Suzanne Krantz, Rittal North America, Schaumburg, IL

3:00 PM - 4:20 PM

Seminar 33 (Intermediate)

Ground Source Heat Pump Systems: GeoMicroDistricts to the Thermal Highway and Beyond LIVE Q&A

Track: Energy Conservation

Room: Virtual

Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: Roshan Revankar, Melink Solar and Geo, Milford, OH

This seminar explores possibilities for wasted energy recovery and increasing multi-building system efficiency using one-pipe convective loops. We demonstrate several ways System Coefficient of Performance can be increased using ground source and GeoMicroDistricts. There will be several sessions that will go over the energy engineering aspects of optimizing GSHP systems

using diversity, part load analysis, system COP and system iCOP_{kW}, the affinity laws for pumps and fans, and earth thermal properties for heat storage. Specific examples of installed GeoMicroDistricts will be used to demonstrate the technology.

1. In the Beginning...

Garen N. Ewbank, Member, Ewbank Geo Testing, LLC, Fairview, OK

2. What Box Do We Use for Ground Source Systems?

Cary Smith, Member, Sound Geothermal Corp., Sandy, UT

3:00 PM - 4:20 PM

Seminar 34 (Advanced)

Performance of Alternative Low GWP A2L Refrigerants in Condensers LIVE Q&A

Track: Refrigeration and Refrigerants

Room: Virtual

Sponsor: 1.3 Heat Transfer and Fluid Flow, 8.4 Air-to-Refrigerant Heat Transfer Equipment, 8.5 Liquid-to-Refrigerant Heat Exchangers

Chair: Kashif Nawaz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Due to the emerging attention to the environmental impacts of air conditioning, there has been a continuous effort to evaluate the heat transfer and pressure drop performance of alternative refrigerants that can substitute conventional working fluids like R410A. This seminar highlights the performance of several low GWP and A2L refrigerants, including zeotropic mixtures of HFC/HFOs, under flow condensation process in heat exchangers. The seminar also highlights conventionally ignored superheated and subcooled condensation process, challenges associated with condensation of zeotropic mixtures, and a novel modeling framework that will facilitate the design of next generation condensers for alternative refrigerants.

1. Thermal-Hydraulic Performance of Alternative Refrigerants under Flow Condensation

Kashif Nawaz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. In-Tube Condensation of Low Global Warming Potential Refrigerants

Tabeel Jacob, Student Member, Oregon State University, Corvallis, OR

3:00 PM - 4:20 PM

Seminar 35 (Intermediate)

Sensors and IAQ LIVE Q&A

Track: Environmental Health Through IEQ

Room: Virtual

Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Brian Krafthefer, P.E., Fellow Life Member, BCK Consulting, Stillwater, MN

IAQ consists of a variety of different contaminants – particles, bio aerosols, gases, and vapors - and household air pollution is ranked one of the largest burdens of disease. To determine the materials that are in the air one needs accuracy and would like to sense these with one small sensor. This seminar looks at some of the current sensing capabilities for indoor IAQ and try to understand what is needed for one sensor to detect multiple contaminants while trying to minimize energy consumption, which are traditionally competing goals.

1. What Did We Learn from Deploying Low-Cost Particle Monitors in 20 Homes?

Jeffrey Siegel, Ph.D., Fellow ASHRAE, University of Texas at Austin, Austin, TX

2. Metal Oxide Semiconductor Sensors to Measure Volatile Organic Compounds for Ventilation Control

Pawel Wargocki, Ph.D., Associate Member, Technical University of Denmark, Kongens Lyngby, Denmark

3. Operating Principles of Airborne Pollutant Sensors and Considerations for Sensing Multiple Pollutants

Jordan Clark, Ph.D., OSU, Columbus, OH

ON-DEMAND SESSIONS

Conference Paper Sessions

Conference Paper Session 1: Energy Master Planning for Resilient Public Communities - Best Practices from Europe and North America

Conference Paper Session 2: Defining and Quantifying the Resilience of Electrical and Thermal Energy Systems in Critical Infrastructure

Conference Paper Session 3: tba

Conference Paper Session 4: Effective Building Performance Characterization and Commissioning Using BIM and Machine Learning

Conference Paper Session 5: Statistical Models and Machine Learning for Minimizing Energy Costs in Buildings

Conference Paper Session 6: Energy Efficiency of Buildings: Code-based Post-installation Measurements, and of Control Systems for Non-invasive Retrofits

Conference Paper Session 7: Energy Consumption and Potential Savings in Residential Dwellings

Conference Paper Session 8: Modelling to Understand and Improve the Energy Efficiency of Buildings

Conference Paper Session 9: Best Operation and Intelligent Control Systems to Enhance Building Energy Efficiency while Guaranteeing the Indoor Desired Conditions

Conference Paper Session 10: PV Panels, PCM (Phase-Change Materials), and the Effects of the Related Equipment on Building Energy Performances

Conference Paper Session 11: Ventilation Strategies to Mitigate the Transmission and Distribution of Airborne Contaminants and Pathogens

Conference Paper Session 12: Novel Sensors, Control Strategies and Computational Methods for Improving Thermal Comfort

Conference Paper Session 13: Approaches for Maintaining Effective Ventilation and Avoiding Adverse Air Quality in Work Environments

Conference Paper Session 14: Applications of Computational Fluid Dynamics To Evaluate and Improve Ventilation

Conference Paper Session 15: tba

Conference Paper Session 16: Air Mixing, Energy Recovery, Duct Sizing, Fire Propagation in Railcars: Descriptions, Analyses and Solutions

Conference Paper Session 17: Energy Saving by Absorption Heat Pumps and from Increased Knowledge of Condensers and Evaporators

Conference Paper Session 18: Modelling for the Estimation of Energy Performance of Buildings and Products

Conference Paper Session 19: Standards and Protocols for Buildings' Energy and Water Usages

Conference Paper Session 20: Handling Environmental Effects on Ventilation Systems

Conference Paper Session 21: tba

Conference Paper Session 22: Heat Pump Feasibility and Field Issues

Conference Paper Session 23: Developments in Chiller System Operations

Conference Paper Session 24: Superheat Regulation, Radiant Systems and District Energy Systems

Conference Paper Session 25: Building Design: International Perspective

Conference Paper Session 26: Improving Performance of Systems and Equipment

Panels

Panel: The Role of Thermally Driven Heat Pumping and Cooling Systems in the Age of Electrification

Panel: Advancing Occupant Aspects of Building Energy Codes, Standards and Policy

Panel: Design Fundamentals of Commercial Kitchens, Part 1

Panel: Design Fundamentals of Commercial Kitchens, Part 2

Seminars

Seminar 36: A Revolution in Buildings: Prefabricated Radiant Structures

Seminar 37: ASHRAE Conference Crash Course

Seminar 38: Best Option for Demand Flexible, Grid Interactive Energy Efficient Buildings: Rule Based Algorithmic Controls or Model Predictive Controls?

Seminar 39: Bridging two worlds: Standards, Guidelines and Codes for Solar Energy Systems in Buildings

Seminar 40: Building-Integrated Photovoltaic Envelope for Cold Climates: Here Comes the Power of the Sun

Seminar 41: Certification of Seismic Brace Systems

Seminar 42: Controls: Can't We All Just Get Along?

Seminar 43: Current Understanding and Gaps of Stability and Compatibility of Low GWP Refrigerants

Seminar 44: Decarbonization and Electrification of the Built Environment: Designing Canada's Future Urban Communities

Seminar 45: Demystifying Thermal Load Calculations for New HVAC&R Engineers

Seminar 46: Design Challenges and Opportunities in Multifamily Projects

Seminar 47: Design to Achieve Net-Zero: Data Sharing and Interoperability Between Building Asset, Design, Rating, and Analysis Software Tools

Seminar 48: Designing For The Future: Time Varying Carbon Metrics For High Performance Building Design

Seminar 49: Easier Said Than Done: Controlling Air Movement in High-Rise Multifamily Buildings

Seminar 50: Elevator Noise, Vibration and Energy Efficiency

Seminar 51: Energy Conservation & Combined Heat & Power - New Technologies for a New World

Seminar 52: Energy Conservation with Heat Recovery Heat Pumps in New Applications or Old Applications with New Refrigerants

Seminar 53: Enhancing and Expanding Point Cloud Collaboration with a Streamlined Workflow, VR and Cloud Visualization

Seminar 54: From Research to Reality: Advances in Liquid Desiccant Technology

Seminar 55: Future Smart Building Operations for Load Flexibility

Seminar 56: Health, Humidity and Humidifiers

Seminar 58: How Will Climate Change Affect Standards, Guidelines and the Way We Design? Part 1: Why Climate Change May Affect the Design of Buildings and Their Systems

Seminar 59: How Will Climate Change Affect Standards, Guidelines, and the Way We Design? Part 2: Application to Loads Calculations and Design Conditions

Seminar 60: How Will Climate Change Affect Standards, Guidelines, and the Way We Design? Part 3 Decarbonization by Smart Grid and Adaptation to Northern Warming

Seminar 61: Hybrid Boiler Innovations and Applications for Energy and Cost Savings

Seminar 62: Improving Refrigeration Safety in Ice Skating Rinks

Seminar 63: Integrated Smart Heating and Cooling Systems

Seminar 64: Integrating Renewable Energy into Residential and Commercial Air Conditioning with Thermal Energy Storage to Resolve Grid and Off-Grid Issues

Seminar 65: International Implications of ASHRAE Moisture Management Standards

Seminar 66: Lessons Learned from COVID-19 and what Engineering Measures can be Adopted to Reduce Infection Risks in Restaurants

Seminar 67: Life Safety Dampers, Back to Basics

Seminar 68: Mechanical Equipment Individual Current Harmonics and Impact on the Building's Electrical Load

Seminar 69: Mechanical Equipment Individual Current Harmonics and Impact on the Building's Electrical Load: HVAC&R Fundamentals and Applications Track

Seminar 70: Modeling of Surfaces Mass Transfer in Indoor Environment

Seminar 71: New Dogs, New Tricks: Air Flow Control Update

Seminar 72: Next Generation Window Technologies for Net Zero Energy Buildings

Seminar 73: Noise and Vibration: Commissioning & Remediation

Seminar 74: Numerical Challenges in Modeling of Vapor Compression Systems and Components

Seminar 75: Present and Future Challenges in Ventilation Unique to Tall Buildings Arising from Epidemics, Health Issues and Climate Change

Seminar 76: Smart Controls and Optimization for Thermal Storage Systems and Connected Communities

Seminar 77: Smart Indoor Environmental Models for Data Centers

Seminar 78: Supplementing Ventilation with Gas-phase Air Cleaning (IEA-EBC Annex 78)

Seminar 79: Sustainable Approaches for Energy Demand in the Community Scale

Seminar 80: System Analysis and Modeling of Variable Refrigerant Flow Systems

Seminar 81: The Impact of COVID-19 on Building Energy Consumption, IAQ and Occupant Behavior

Seminar 82: The Impacts and Value of ASHRAE Standards and Technology

Seminar 83: Thermal Energy Storage in Geothermal Systems

Seminar 85: Unique and Necessary Approaches and Considerations When Commissioning Commercial Kitchen Ventilation Systems

Seminar 86: Use of Reflective Technology in Buildings

Seminar 87: What Makes a Compressor a Heat Pump Compressor?

Seminar 88: Whole Greater Than the Sum: Coupling Building Simulation Techniques

Seminar 89: Window Shading – How to Save Energy while Improving Occupant Comfort and Visual Environmental Quality?