

2019 ASHRAE Winter Conference

January 12th – January 16th, 2019



<https://www.ashrae.org/atlanta>

The Technical Program along with Committee meetings, Registration, the Bookstore and Speakers Lounge will be at the Omni CNN Center and the Georgia World Congress Center.

Updated December 21, 2018

Sunday, January 13

Sunday, January 13, 8:00 AM - 9:00 AM
Debate 1 (Basic)

Should Sex Sell HVAC Equipment?

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: 7.6 Building Energy Performance

Chair: Cindy Moreno, Member, T & M Mechanical Sales Co., Mesa, AZ, Pam Duffy, Member, Lennox International, Dallas, TX, Jessica Mangler, P.E., Member, Affiliated Engineers, Inc., Seattle, WA, William P Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Penn State, University Park, PA, Ronald Jarnagin, Pacific Northwest National Lab, Richmond, WA, Alyse Falconer, P.E., Member, Point Energy Innovations, San Francisco, CA and Carrie Anne Monplaisir, Associate Member, Clark Nexsen, Virginia Beach, VA

Sex sells, but should it? Thanks to grassroots efforts from groups like ASHRAE, the demographic of the HVAC industry is becoming more diverse. However, marketing practices do not appear to be changing along with the industry's demographics. Some businesses in the HVAC industry use "booth babes" and other provocative marketing strategies to promote their brands and sell their equipment. What is the most effective way for these businesses to draw the eyes of their customers?

8:00 AM - 9:00 AM

Conference Paper Session 1 (Intermediate)

Energy Modeling Simulations

Track: HVAC&R Fundamentals and Applications

Room: Building A, A408

Chair: Samir Traboulsi, P.Eng., Fellow Life Member, Thermotrade/Ranec, Beirut, Lebanon

Several programs and methodologies exist for energy modeling. Three case studies are presented using different techniques for energy modeling and how to apply them.

1. HAMT Extension for EnergyPlus Encompasses Moisture Sources Due to Air Leakage (AT-2019-C001)

Florian Antretter, Member¹ and Simon Pallin, Ph.D., Associate Member², (1)Fraunhofer IBP, Holzkirchen, Germany, (2)Oak Ridge National Laboratory, Oak Ridge, TN

2. Accuracy of a Crude Approach to Urban Multi-Scale Building Energy Models Compared to 15-min Electricity Use (AT-2019-C002)

Eric Garrison¹, Joshua New, Member² and Mark Adams, Associate Member³, (1)UTK, Knoxville, TN, (2)Oak Ridge National Laboratory, Knoxville, TN, (3)Oak Ridge National Laboratory, Oak Ridge, TN

3. Challenges of Creating a Verifiable Building Energy Model (AT-2019-C003)

Ali Razban, Ph.D., P.E., Associate Member, Daniel Sebastian, Member and Jayraj Ligade, Student Member, IUPUI, Indianapolis, IN

8:00 AM - 9:00 AM

Conference Paper Session 2 (Intermediate)

Examples of Cost Saving Initiatives

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A303

Chair: Jaya Mukhopadhyay, Ph.D., Member, Montana State University, Bozeman, MT

Different methods can be used to provide cost savings in the built environment. This session contains three papers on different methods. First is a feasibility study, then a commissioning tool and last is a program to optimize an existing system.

1. Economic Feasibility of Combined Cooling, Heating and Power Systems (AT-2019-C004)

Hyeunguk Ahn, Student Member, Donghyun Rim, Ph.D. and James Freihaut, Member, Pennsylvania State University, State College, PA

2. Field Demonstration of an Automated Building Commissioning Tool (AT-2019-C005)

Hayden Reeve, Ph.D., Member¹, Anarta Ghosh², Buyun Jing², Rohan Chabukwar², Yun Li² and Zhengang Zhu², (1)Pacific Northwest National Labs, Seattle, WA, (2)United Technologies Research Center, East Hartford, CT

3. Optimization of Condenser Water Loop Control in Hot and Humid Climates (AT-2019-C006)

Lei Wang, Ph.D., P.E., Member, Steven Bowman and Yasuko Sakurai, Utilities & Energy Services, Texas A&M University, College Station, TX

8:00 AM - 9:00 AM
Seminar 1 (Intermediate)

Advances in Hybrid HVAC Efficiency and Performance

Track: Systems and Equipment

Room: Building A, A305

Sponsor: 5.7 Evaporative Cooling

Chair: Jonathan Woolley, University of California, Berkeley, Berkeley, CA

Hybrid HVAC equipment takes advantage of climate appropriate strategies to achieve outstanding efficiencies and reductions in peak power demand. These benefits are realized without compromising performance or impacting building occupants or operators. A number of efforts are converging to increase the adoption of hybrid approaches. This seminar highlights advances in energy simulation/analysis and real world implementation of evaporative/DX hybrids needed to rise to the challenges being placed on 21st century HVAC systems.

1. New Hybrid HVAC Modeling Capability in EnergyPlus Building Energy Simulation

Spencer Dutton, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

2. Hybrid Indirect Evaporative/DX Capacity Modeling

Steven Slayzak, Associate Member, Seeley International, Denver, CO

3. RTU Optimization: Fixed Compressor Speed Reduction and Condenser-Air Pre-cooling

Caton Mande, UC Davis Western Cooling Efficiency Center, Davis, CA

4. Growing the Pre-Cooling Market with Pre-Sold Maintenance

Steve Short, Integrated Comfort Inc., West Sacramento, CA

8:00 AM - 9:00 AM
Seminar 2 (Intermediate)

Steps toward Net Zero for the Marine Corps Logistics Base at Albany GA

Track: Renewables and Natural Systems

Room: Building A, A301

Sponsor: 9.1 Large Building Air-Conditioning Systems, 6.7 - Solar and other Renewable Energies

Chair: Alonzo Blalock, P.E., Member, Jacobs Engineering, Fort Worth, TX

The Marine Base at Albany, GA has been moving toward the aspect of Net Zero operations in steps of varied methods and this seminar is a recap of some of those elements. Step 1 is the addition of Sustainable Power by installation of a 31 MW PV Facility in cooperation with Georgia Power. Step 2 is the application of BTES system and application of Ground Source Heat Pump technology to improve energy efficiency in replacement of HVAC at the Base. Step 3 is the use of Retro Commissioning to review existing facility operations and make modifications for minimizing energy consumption.

1. Step One: Addition of 31 MW PhotoVoltaic Facility at MCLB Albany

William Houser, P.E., Georgia Power, Atlanta, GA

2. Step Two: Installation of BTES system at MCLB Albany

Chuck Hammock, P.E., Associate Member, Andrews, Hammock & Powel, Inc., Macon, GA

3. Step Three: Maximizing by Retro-Commissioning

Robert Bucey, P.E., Member, Jacobs, Dallas, TX

8:00 AM - 9:00 AM
Seminar 3 (Intermediate)

Tales from the Crypt

Track: Common System Issues and Misapplications

Room: Building A, A302

Sponsor: 7.7 Testing and Balancing

Chair: Thomas Schlachter, P.E., Member, Engineered Air Balance Co Inc, Richardson, TX

So much of what is presented at the ASHRAE conferences is highly technical and related to new ideas, procedures and equipment. We all learn from our mistakes, this is called experience. The theme of this program is sharing. The purpose in sharing our experiences is to help others (younger and possibly less experienced) in their decision making process and possibly eliminate the mistakes others have made in the past.

1. Tales from the Crypt

Thomas Schlachter, P.E., Member, Engineered Air Balance Co Inc, Richardson, TX

2. Best Laid Plans: Cautionary Tales for Designers and Engineers

Donald Prather, HFDP, Member, Air Conditioning Contractors of America, Arlington, VA

8:00 AM - 9:00 AM
Seminar 4 (Intermediate)

Thermal Energy Storage in the Cold Chain

Track: HVAC&R Fundamentals and Applications

Room: Building A, A404

Sponsor: 6.9 Thermal Storage

Chair: Eric House, H I Solutions, Inc., Kennesaw, GA

Thermal Energy Storage (TES) technology provides energy flexibility and efficiency particularly in high-consuming refrigeration applications (grocery stores and distribution centers). Low-temperature cold storage facilities require the highest energy demand per cubic foot of any industrial electricity load. TES provides significant operational and financial benefits to cold storage operators, grocers and utilities challenged to manage the peak loads of the electrical grid. In a 93,000 square foot low-temp facility TES reduced peak period consumption by 43% and peak demand by 29% while maintaining 50% more stable temperatures. In a 320 square foot grocery freezer peak period run time was reduced 60%.

1. Thermal Energy Storage in the Cold Chain (Part 1)

Collin Coker, Viking Cold Solutions, Houston, TX

2. Thermal Energy Storage in the Cold Chain (Part 2)

John Lerch, Axiom Exergy, Richmond, CA

8:00 AM - 9:00 AM
Workshop 1 (Intermediate)

Construction, Operation and Maintenance of High Performance Systems of Large Central Plants and Distribution Systems

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A405

Sponsor: 7.3 Operation and Maintenance Management

Chair: Sonya Pouncy, Member, Energy Sciences, Detroit, MI

The recent case studies regarding natural disasters has impacted the way we operate and maintain Large Central Plant(s) distribution systems, during emergency power outages and system restoration. Large Central Plants operating on emergency power and its reliability is vital to businesses IT infrastructure, research, healthcare facilities and mission critical systems. Power Plant Engineers and Operations and Maintenance staff maintaining Municipalities, Colleges, Hospitals, Research Institutes and Military Installations must become more knowledgeable of emergency management teams roles and responsibilities.

1. Construction, Operation, and Maintenance of High Performance Systems of Large Central Plants and Distribution Systems

Terrence Rollins, Member¹, Tim Anderson² and Mitchell Swann, P.E.³, (1)RHC Global Energy Solutions, Corpus Christi, TX, (2)Applied Engineering Services, Inc, Indianapolis, IN, (3)MDC Systems, Paoli, PA

2. Construction, Operation and Maintenance of High Performance Systems of Large Central Plants and Distribution Systems

Sonya Pouncy, Member, Energy Sciences, Detroit, MI

9:00 AM - 12:00 PM
Seminar TC (Intermediate)

Defining Health

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room:

Sponsor: SGPC 10

Chair: Walter Grondzik, P.E., Fellow ASHRAE, Ball State University, Muncie, IN

ASHRAE SGPC 10 is interested in the topic of health relative to its charge to maintain a document that comprehensively addresses Interactions Affecting the Achievement of Acceptable Indoor Environments. "Acceptable" involves comfort and health, but definitions of health are elusive (and often circular). The objective of this interactive workshop is to explore "health" through a structured interaction between the session presenters, panels members from diverse disciplines, and the audience. The intended outcome is a better understanding of how to define health in the context of building environmental variables.

1. Defining Health

Carl Grimes, Member¹ and Frederick Marks, AIA², (1)Hayward Healthy Home, Denver, CO, (2)Visiting Scholar, Salk Institute for Biological Studies, La Jolla, CA

Sunday, January 13, 9:45 AM - 10:45 AM
Technical Paper Session 1 (Intermediate)

ASHRAE Research on Ductwork

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A303

Chair: Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

Understanding noise propagation in ductwork is an essential component when designing ventilation systems. This session discusses current ASHRAE sponsored research on characterizing noise propagation and insertion loss in ducts.

1. A Review of Prior ASHRAE Research Efforts to Characterize Noise Propagation in Ducts (AT-2019-001)

David Herrin, Associate Member, University of Kentucky, Lexington, KY

2. The Effect of Length on the Insertion Loss of Fiberglass Lined Sheet Metal Ducts, Part I: Rectangular Duct (RP-1408) (AT-2019-002)

Michael Schwob, Member, Schwob Acoustics, Las Vegas, NV

3. The Effect of Length on the Insertion Loss of Fiberglass Lined Sheet Metal Ducts, Part II: Round Duct (RP-1408) (AT-2019-003)

Michael Schwob, Member, Schwob Acoustics, Las Vegas, NV

9:45 AM - 10:45 AM

Conference Paper Session 3 (Intermediate)

Using Buildings to Improve Hydronic Efficiency

Track: Renewables and Natural Systems

Room: Building A, A408

Chair: Peng Yin, Ph.D., Associate Member, University of Louisiana at Lafayette, Lafayette, LA

Thermo active building systems use the concrete in buildings to improve hydronic system efficiency. Building on this technology, three papers are presented on the application of these systems or modifications based on the same principal. Come experience new energy efficient strategies.

1. Surface Condensation Control for Concrete Core Systems Utilizing Model Predictive Control (AT-2019-C007)

Deok-Oh Woo, BEAP, Student Member, University of Michigan, Ann Arbor, MI

2. Applying TABS to a Publishing Company Headquarters Using Integrated Design (AT-2019-C008)

Kosuke Sato, Member¹, Eri Kataoka, Member¹, Jun Shionda, BEAP, Student Member², Shin-ichi Tanabe, Ph.D., BEAP, Fellow ASHRAE³ and Susumu Horikawa, Member¹, (1)NIKKEN SEKKEI LTD, Tokyo, Japan, (2)Waseda University, Tokyo, Japan, (3)Department of Architecture, Waseda University, Tokyo, Japan

3. Hybrid GEOTABS: System Concept, Individual Modules and Interfaces (AT-2019-C009)

Dolaana Khovalyg, Associate Member¹, Bjarne Olesen, Ph.D., Presidential Member¹, Gerald Parnis², Jiří Cigler, Ph.D.³ and Ongun Kazanci, Ph.D., Associate Member¹, (1)Danish Technical University, Lyngby, Denmark, (2)Boydens Engineering, Zedelgem, Belgium, (3)Energoklastr, Prague, Czech Republic

9:45 AM - 10:45 AM

Seminar 5 (Basic)

ASHRAE Conference Crash Course

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: 7.6 Building Energy Performance

Chair: Vanessa Freidberg, P.E., Member, Siemens Building Technologies, Austin, TX

First time at an ASHRAE Conference? Been coming for years, but still confused? What is a TC? What is a Standing Committee? Who can attend what? What is the AHR Expo? And why is all this happening at once? This crash course provides all attendees with an introduction to all the ASHRAE Conference activities, explains how you can get involved, and allows you to ask questions to experienced attendees.

1. The Ins and Outs of ASHRAE

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

2. Make the Most of Your Conference Experience

Madison Schultz, P.E., Member, Guernsey Engineers/Architects/Consultants, Oklahoma City, OK

9:45 AM - 10:45 AM

Seminar 6 (Intermediate)

Condensing High-Efficiency Boilers and Their Proper Operation and Maintenance

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A405

Sponsor: 6.1 Hydronic and Steam Equipment and Systems

Chair: Rex Scare, P.E., Member, Armstrong International Inc, Three Rivers, MI

The seminar reviews the various building mechanical components that influence the low temperature operating range that will provide return water temperature to allow a condensing boiler to operate in condensing mode and optimize its operating efficiency, while minimizing the operating cost to heat the building. It also addresses common installation, operation, maintenance and control pitfalls that may reduce operating efficiency in high efficiency condensing boiler systems. Proper selection of equipment, water chemistry and pumping strategies are also discussed.

1. The Design Factors that go into Providing a High Efficiency Condensing Boiler Heating System and Having the System Perform as Intended Once Installed and Throughout its Life

Thomas Neill, Member, Mestek Inc, Southampton, MA

2. High Efficiency Boiler Operation, Maintenance and Control for Efficient Operation

Ted Duffy, P.E., Member, LAARS Heating Systems Company, Rochester, NH

9:45 AM - 10:45 AM

Seminar 7 (Intermediate)

Critical Mobile Food Refrigeration Systems Using Low-GWP Refrigerants

Track: Refrigeration

Room: Building A, A302

Sponsor: 10.6 Transport Refrigeration

Chair: William Murphy, Ph.D., P.E., Fellow Member, University of Kentucky, Paducah, KY

While we typically think of commercial food refrigeration as being associated with grocery stores or over-the-road transport, there are a number of critical applications for refrigeration needed in support of deployed military personnel. This session addresses novel system designs using low-GWP refrigerants supporting both field and submarine personnel. These refrigeration systems can provide for food storage above and below freezing and must operate satisfactorily under extreme design conditions. The success of these systems indicate that low-GWP refrigerants can be successfully used for food refrigeration in even the most demanding applications.

1. Design of a Refrigerated Transport Container Using CO₂ (R744) as a Refrigerant

Neal Lawrence, Ph.D., Associate Member, Creative Thermal Solutions, Urbana, IL

2. Mission Critical Submarine Food Refrigeration System Using R1234ze as a Refrigerant

Augusto San Cristobal, Bronswerk, Brossard, QC, Canada

9:45 AM - 10:45 AM

Seminar 8 (Intermediate)

Sustainable Building Operation via ASHRAE Standard 189.1 and Lessons Learned

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A305

Sponsor: MTG.EBO - Effective Building Operations

Chair: Sonya Pouncy, Member, Energy Sciences, Detroit, MI

This session illustrates how using ASHRAE Standard 189.1 can provide the foundation of Sustainable Building Operation for Higher Performance of building owner expectations through a roadmap of mandatory maintenance procedures and documentation. This seminar also illustrates lessons learned through direct experience with high performance buildings as to the owner expectations for sustainable operation.

1. Sustainable Building Operation via Standard 189.1

Douglas Zentz, Associate Member, Ferris State University, Big Rapids, MI

2. Lessons Learned for Sustainable High Performance Building Operation

Stephen Hamstra, P.E., Member, Melink Solar & Geo, Detroit, MI

9:45 AM - 10:45 AM
Seminar 9 (Intermediate)

The Doctor is In! Diagnosing Common System Issues and Misapplications in Building Automation Systems

Track: Common System Issues and Misapplications

Room: Building A, A404

Sponsor: 1.4 Control Theory and Application

Chair: Frank Shadpour, P.E., Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

A building automation system is the central nervous system of the HVAC system, but most engineers tasked to run a facility through these systems see them only as black boxes. Designed and configured correctly, they become a force multiplier for operations personnel. Configured sub-optimally, they become a liability and create additional problems to distract facility operators from their primary responsibilities. But how can anyone determine the proper configuration of a system built with proprietary software and programming language? This seminar presents proven methods for non-controls technicians to identify and address common issues present in existing building automation systems.

1. Assessment Tools and Techniques for Existing Building Automation Systems

Joseph Kilcoyne, P.E., Member, SC Engineers, Inc., San Diego, CA

2. Simple Misapplications of Control Systems in Hospitals and How to Avoid Them

Daniel Farrow, Palomar Health, San Diego, CA

9:45 AM - 10:45 AM
Seminar 10 (Basic)

What's New in Cybersecurity

Track: Systems and Equipment

Room: Building A, A301

Sponsor: 1.5 Computer Applications

Chair: Michael Galler, Member, National Institute of Standards and Technology, Gaithersburg, MD

As with mechanical building systems, the requirements to stay current in Cybersecurity are constantly evolving. These seminars provide updated information relating to Cybersecurity and a some of the speakers' experiences in the field.

1. Building Automation Systems + Cybersecurity

Levi Tully, Member, Reliable Controls, Columbus, OH

2. SmartBuilding Technology: In The Hacker's Crosshairs

Fred Gordy, Member, Intelligent Buildings, Atlanta, GA

Sunday, January 13, 11:00 AM - 12:30 PM
Conference Paper Session 4 (Intermediate)

Modeling HVAC Systems

Track: HVAC&R Fundamentals and Applications

Room: Building A, A303

Chair: David Yashar, Ph.D., P.E., Member, National Institute of Standards and Technology, Gaithersburg, MD

CFD and numerical tools have advanced in recent years and are currently used for enhancing design. These papers highlight some of these methods and illustrate their use.

1. Computational Fluid Dynamics (CFD) Modeling of Indoor Chemical Reactions Under Varied HVAC Operating and Lighting Conditions (AT-2019-C010)

Youngbo Won, Student Member¹ and Donghyun Rim, Ph.D., Associate Member², (1)Penn State University, University Park, PA, (2)Pennsylvania State University, University Park, PA

2. Model-based and Data-driven Anomaly Detection for Heating and Cooling Demands in Office Buildings (AT-2019-C011)

Araz Ashouri, Ph.D., Associate Member¹, Guy Newsham, Ph.D.¹, H. Burak Gunay, Student Member², Weiming Shen, Ph.D.¹ and Yitian (Vera) Hu¹, (1)National Research Council Canada, Ottawa, ON, Canada, (2)Carleton University, Ottawa, ON, Canada

3. Optimizing Building Performance using Stochastic Occupant Models (AT-2019-C012)

Mohamed Ouf, Ph.D., Member, H. Burak Gunay, Student Member and William O'Brien, Ph.D., Member, Carleton University, Ottawa, ON, Canada

4. Toward Machine Learning-based Prognostics for Heating Ventilation and Air-Conditioning Systems (AT-2019-C013)

Chunsheng Yang, Ph.D.¹, H. Burak Gunay, Student Member², Weiming Shen¹ and Zixiao Shi, Student Member¹, (1)National Research Council Canada, Ottawa, ON, Canada, (2)Carleton University, Ottawa, ON, Canada

11:00 AM - 12:30 PM
Seminar 11 (Intermediate)

Building HVAC System Control Strategies to Interact with the Modern Electric Grid

Track: Renewables and Natural Systems

Room: Building A, A301

Sponsor: 7.5 Smart Building Systems

Chair: Carlos Haiad, P.E., Member, JCH Energy Management Solutions, Inc., Phillips Ranch, CA

From renewable energy resources to battery storage, building-grid interaction is an everyday event and HVAC designers and building operators must be able to design and operate the systems in the buildings to optimize this interaction. This seminar focuses on the next generation of HVAC system control strategies that allows buildings to interact with solar PV/battery storage/microgrid systems and the electric grid in an innovative and efficient way. An overview of the electric grid followed by several field and laboratory examples of different HVAC system control strategies to maximize grid reliability and building cost and energy savings are also presented.

1. The Value of HVAC Control In Transforming Electric Grids

Carlos Haiad, P.E., Member, JCH Energy Management Solutions, Inc., Phillips Ranch, CA

2. The Feasibility, Economics and Challenges of Using HVAC Systems for Power Grid Regulation Services

Jie Cai, Ph.D., University of Oklahoma, Norman, OK

3. Demonstration of Integrated Air- and Water-side HVAC Strategies for Demand Response on a University Campus

Thomas Lawrence, Ph.D., Fellow ASHRAE, University of Georgia, Athens, GA

4. Impacts of On-Site Battery Storage on HVAC and Other Facility Loads Control Strategies for Peak Load Management and Demand Response Programs

Glenn Remington, Member, Consumers Energy, Jackson, MI

11:00 AM - 12:30 PM
Seminar 12 (Intermediate)

Life After R-404A

Track: Refrigeration

Room: Building A, A305

Sponsor: 10.7 Commercial Food and Beverage Refrigeration Equipment

Chair: Jon Murray, Structural Concepts Corp., Muskegon, MI

This session articulates what happens when the EPA delists a refrigerant and what is involved in replacing it with an alternate. How to go about the selection process of an alternate? What regulatory considerations are there? What about using flammable A3's as alternates? This session discusses the testing aspect of replacements and cites past transition examples.

1. Using A3s (Hydrocarbons) in Self-contained Equipment

Daryl Erbs, Ph.D., Member, Welbilt, Newport Richey, FL

2. Regulatory/Policy Side of Refrigerant Transitions

Rajan Rajendran, Ph.D., Associate Member, Emerson Climate Technologies, Inc., Sidney, OH

3. Laboratory Measurements of R407H for Commercial Refrigeration Applications

Ivan Rydkin, Associate Member, Daikin America, Inc., Orangeburg, NY

4. No Pain no Gain: Transition from R-502 to R-22 to R-404A to ???

Dave Demma, Member, United Refrigeration Inc., Philadelphia, PA

11:00 AM - 12:30 PM
Seminar 13 (Intermediate)

Load-based Testing: Adapting Test Methods for Building's Changing Needs and/or the Equipment's Emerging Features

Track: Systems and Equipment

Room: Building A, A405

Sponsor: 8.11 Unitary and Room Air Conditioners and Heat Pumps

Chair: Zhiwei 'Joy' Huang, Ph.D., Member, Johnson Controls, Norman, OK

This session focuses on the testing techniques improvements and projections for heat pumps and air conditioners. Existing index IEER and SEER fail to properly capture the dynamic effects and potential energy savings of advanced unit controls. This seminar discusses different load based testing methods in order to provide a figure of merit for air conditioners and heat pumps. Test procedures, lab requirement as well as system performance are discussed. This seminar also covers the test procedure changes in DOE Appendix M1. Overall, this seminar provides the current research development and standard change on load-based testing method of air conditioners.

1. RP-1608: Load-Based Testing as a Means for Understanding Part-load Performance of Rooftop Units

Pedro Perez, AAON, Inc., Tulsa, OK

2. A Load-Based Testing Approach for HVAC Equipment using Emulation of Building Response

James Braun, Ph.D., Fellow ASHRAE, Purdue University, West Lafayette, IN

3. Seasonal Performance Rating of Heat Pumps and Air Conditioners using Load-Based Testing

James Braun, Ph.D., Fellow ASHRAE, Purdue University, West Lafayette, IN

4. Test Procedure Changes in DOE Appendix M1 and Compliance with the Residential Air Conditioners and Heat Pumps Standards in 2023

Wongyu Choi, Ph.D., Member, AHRI, Arlington, VA

11:00 AM - 12:30 PM

Seminar 14 (Intermediate)

Multiscale Building Energy Modeling, Part 10

Track: HVAC&R Fundamentals and Applications

Room: Building A, A408

Sponsor: 4.7 Energy Calculations

Chair: Ron Judkoff, Member, National Renewable Energy Laboratory, Golden, CO

Development of urban- or multiscale building energy models is becoming increasingly tractable for many applications including city-wide energy supply/demand strategies, urban development planning, electrical grid stability, and urban resilience. This seminar has assembled researchers from three U.S. national laboratories with capabilities in the field of multiscale energy models to discuss an overview of the field as well as the data, algorithms, workflow, and practical challenges addressed in their applications involving creation and analysis of building energy models at the scale of a city or metropolitan area.

1. Evaluating the Impact of the Urban Context on Building Energy Modeling

Xuan Luo, Carnegie Mellon University, Pittsburgh, PA

2. Modeling Zero Net Energy Communities

Daniel Macumber, Member, National Renewable Energy Laboratory, Golden, CO

3. AutoBEM Capabilities for Creating a Digital Twin of a Utility

Joshua New, Member, Oak Ridge National Laboratory, Knoxville, TN

11:00 AM - 12:30 PM

Seminar 15 (Intermediate)

Occupant-centric Control Technologies: Assessing Comfort, Energy Use and Cost Tradeoffs

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A404

Sponsor: MTG.OBB Occupant Behavior in Buildings

Chair: Marina Sofos, U.S. Department of Energy, Washington, DC

Recent years have seen accelerated development of building technologies that enable real time direct and/or indirect occupant control of HVAC, lighting, and plug loads. Measured and simulated tests of these occupant-centric control technologies suggest that their energy savings potential may be substantial but that savings are highly uncertain and could come at the expense of reduced occupant comfort and/or higher installed cost. This seminar seeks to clarify the definition of occupant-centric control measures and explore the degree to which these measures can balance the sometimes competing objectives of occupant comfort, energy use, and cost of deployment.

1. Developing Prospective National Technology Goals for Occupant-centric Measures

Jared Langevin, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

2. LightLearn: Reinforcement Learning for Occupant Centered Control and Controller Performance Metrics

Jose Vazquez-Canteli, The University of Texas at Austin, Austin, TX

3. Personalized Comfort Modeling for Occupant-centric Environmental Control

Joyce Kim, Student Member, University of California, Berkeley, Berkeley, CA

4. FORK: A Platform for Building Controls Using Accurate Real-Time Occupancy and Thermal Comfort Preference Estimations

Mario Berges, Ph.D., Carnegie Mellon University, Pittsburgh, PA

11:00 AM - 12:30 PM
Seminar 16 (Intermediate)

The Best of Engineer's Notebook 3rd Edition

Track: Common System Issues and Misapplications

Room: Building A, A410

Sponsor: 9.1 Large Building Air-Conditioning Systems

Chair: Kelley Cramm, P.E., Member, Henderson Engineers, Lenexa, KS

The "Engineer's Notebook" series in ASHRAE Journal was established in its current form in 2013, with four authors contributing monthly articles on a rotating basis. All four authors are ASHRAE Fellows and senior consulting engineers with many years of practical experience, and the concept of the recurring column is to share with peers what they have learned (sometimes the hard way) and experienced in the course of their careers, along with helpful design tips and tools. In this seminar, each of the four has chosen another of their favorite columns to date, and has adapted it for presentation.

1. Data Centers, Cooling Towers and Thermal Storage

Daniel H Nall, WSP Flack + Kurtz, New York, NY

2. Designing Pipe Insulation Systems

Kent W. Peterson, P.E., BEAP, Presidential Fellow ASHRAE, P2S Engineering, Inc., Long Beach, CA

3. Making VAV Great Again

Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

4. N+1 HVAC for IT Closets and Server Rooms

Stephen W. Duda, P.E., BEAP, HBDP and HFDP, Fellow ASHRAE, Ross & Baruzzini, Inc., St. Louis, MO

11:00 AM - 12:30 PM
Workshop 2 (Advanced)

Turning to Old Buildings: Optimizing and Upgrading Our Existing Building Stock

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A302

Sponsor: 7.9 Building Commissioning, YEA Committee

Chair: Cindy Moreno, Member, T & M Mechanical Sales Co., Mesa, AZ

Throughout the United States, construction costs are increasing while open land for new construction use is diminishing. How do we assist owners, developers and school districts in making the most of existing buildings? This session explores the financial aspect of upgrading existing buildings, explore energy reduction ideas, equipment replacement projects and the financial calculations and incentives which assist owners in penciling out the subsequent budgets. Engineers learn how to motivate and educate owners on how to invest in their existing portfolio stock while reducing overall building energy use.

1. Exploring the Financials: Motivating Building Owners to Upgrade Energy Systems

Alyse Falconer, P.E., Member, Point Energy Innovations, San Francisco, CA

2. Barriers to Successful Building Owner Energy Savings Initiatives

Richard Danks, P.E., Member, Cleveland, OH

3. Leveraging Utility Rebates in Offices and Multi-Family Residential Buildings

James Falconer, Member, Affiliated Engineers, San Francisco, CA

4. All the Design Elements We Cannot See: A Case Study of Barrington School District 220

Shona O'Dea, Member, DLR Group, Chicago, IL

Sunday, January 13, 1:30 PM - 3:00 PM
Conference Paper Session 5 (Intermediate)

Analysis of HVAC Systems for Specific Applications

Track: HVAC&R Fundamentals and Applications

Room: Building A, A408

Chair: Ramesh Tiwari, Ph.D., Member, University of Maryland, College Park, MD

Data centers and hospitals have unique requirements for their design. Data centers consume large amounts of power and generate a lot of heat. Hospitals have unique needs with respect to air movement and ventilation. This sessions highlights methods to simulate those environments to achieve optimal design.

1. Power Consumption Simulator of Data Center by using Computational Fluid Dynamics and Machine Learning (AT-2019-C014)

Hayato Kuwahara, BEAP, Kazuhiro Matsuda, M.D., BEAP, Member, Morito Matsuoka, Member and Ying-Feng Hsu, BEAP, Osaka University, Osaka, Japan

2. The Effect of Forced Air Warming Devices on Surgical Site Infection (AT-2019-C015)

Abdel Darwich, P.E., HFDP, Member, Fatih Turan and Suhasini Pyarasani, Guttman & Blaevoyet, Sacramento, CA

3. Analysis of Displacement Ventilation for Hospital Patient Rooms (AT-2019-C016)

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

4. A New Fast Fluid Dynamics Model for Data-Center Floor Plenums (AT-2019-C017)

Wei Tian, Ph.D., Student Member¹, Christopher Healey, Ph.D.², James W. VanGilder, P.E., Member¹, Michael Condor¹, Wangda Zuo, Ph.D., Member³ and Xu Han, Student Member³, (1)Schneider Electric, Andover, MA, (2)Schneider-Electric, Andover, MA, (3)University of Colorado Boulder, Boulder, CO

1:30 PM - 3:00 PM

Conference Paper Session 6 (Intermediate)

Maximizing Thermal Comfort and International Design

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A303

Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

Maximizing and quantifying thermal performance is a key parameter in building design. Presented here are studies on the thermal occupant satisfaction and the impact on thermal performance on occupant satisfaction.

1. The Assumption of Equidistance in the Seven-Point Thermal Sensation Scale and a Comparison between Categorical and Continuous Metrics (AT-2019-C018)

Sama Aghniaey, Ph.D., Student Member and Thomas Lawrence, Ph.D., Fellow ASHRAE, University of Georgia, Athens, GA

2. Predicting Thermal Comfort in Mixed-mode Office Building in the UK (AT-2019-C019)

Xiaoyan Luo, Student Member, Dulhas Maliyekkal-Kanhirothkandi, Associate Member, Faisal Durrani, Ph.D. and Mahroo Eftekhari, Ph.D., Member, Loughborough University, Loughborough, United Kingdom

3. Maximize Thermal Comfort in Open-plan Offices by Occupant-oriented Control Based on Individual Thermal Profile (AT-2019-C020)

Wanni Zhang and Chenlu Zhang, Carnegie Mellon University, Pittsburgh, PA

4. Quantifying the Importance of Measured Metabolic Rates and Clothing Levels for Effectively Using a Predicted Mean Vote Model: A Global Sensitivity Analysis (AT-2019-C021)

Jerry Thomas, Student Member, Amanda Smith, Associate Member and Tiffany Swenson, University of Utah, Salt Lake City, UT

1:30 PM - 3:00 PM

Seminar 17 (Intermediate)

Building Integrated Renewable Fueled Natural Refrigeration Systems

Track: Renewables and Natural Systems

Room: Building A, A405

Sponsor: 8.3 Absorption and Heat Operated Machines

Chair: William Ryan, Ph.D., P.E., Member, University of Illinois at Chicago, Chicago, IL

This seminar covers any absorption application, whether chillers, air conditioners, dehumidifiers, heat pumps or heat transformers using any natural solution pair (LiBr/Water, Ammonia/Water, or Other) used in conjunction with any system fired by a renewable fuel or low grade waste heat including Case Studies, Future Planning, System analysis or policy Issues and Research Issues.

1. Biomass Power Production in Austria

Douglas Davis, Member, Capstone, Wexford, PA

2. Waste Heat Driven Cooling and Heating Technologies

Rajesh Dixit, Associate Member, Johnson Controls, Inc., York, PA

3. Efficient Dehumidification using a Compact Membrane-based Ionic Liquid Absorption Cycle

Saeed Moghaddam, Ph.D., University of Florida, Nanoengineered Energy Systems (NES) Laboratories, Gainesville, FL

1:30 PM - 3:00 PM

Seminar 18 (Intermediate)

"Hot Topics for Hotlanta": Emerging Applications and Markets for UVC

Track: Systems and Equipment

Room: Building A, A301

Sponsor: 2.9 Ultraviolet Air and Surface Treatment

Chair: Sam Guzman, Member, American Ultraviolet Company, Hackettstown, NJ

This seminar informs the attendees about some of the emerging markets for UVC equipment and address hot topics like Legionella control, cannabis farming and UVC for Healthcare. Outbreaks, crop health and HAIs are big concerns and as some of the most common and ubiquitous pathogens develop a resistance to the most widely used antibiotics building engineers, facility managers, business owners and home owners have turned to UVC for help in creating and maintaining a safe indoor environment. These are some of the reasons that have created new and renewed demand for UVC systems and equipment.

1. Legionella: Need Additional Tools to Control It?

Scott Sherwood, Eco Care Corporation, New York, NY

2. Cannabis: Can UV Make my Grass Grow?

Benoit Despatis, P.Eng., Member, Sanuvox Corporation, St-Laurent, QC, Canada

3. Healthcare: Can UVC Reduce Drug Resistant Hospital Acquired Infections?

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

1:30 PM - 3:00 PM

Seminar 19 (Advanced)

Not Too Little, Not Too Much, Just Right: ASHRAE Standard 62.1 Demand Controlled Ventilation and RP-1747

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A305

Sponsor: 4.3 Ventilation Requirements and Infiltration

Chair: Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

ASHRAE has funded two research projects to develop control sequences for VAV systems that meet Standard 62.1 Ventilation Rate Procedure requirements dynamically using CO2 and occupancy sensors while minimizing energy use. The first project (RP1547, completed in 2013) established the fundamentals of CO2 demand controlled ventilation and theoretical control logic to optimize energy performance. This seminar discusses the final results of the second project (RP-1747) which included developing detailed direct digital control logic that was then successfully validated with field tests and simulations.

1. A Practical Demand Controlled Ventilation Strategy for Multiple Zone VAV Systems and Standard 62.1 (RP-1747)

Hwakong Cheng, P.E., Member, Taylor Engineering LLC, Alameda, CA

2. Field Testing of the RP-1747 Demand Controlled Ventilation Logic

Xiaohui Zhou, Ph.D., Member, Seventhwave, Madison, WI

3. Energy Savings from Demand Controlled Ventilation and the Impact of Sensor Error: Simulation Results from RP-1747

Zheng O'Neill, Ph.D., P.E., Member, The University of Alabama, Tuscaloosa, AL

1:30 PM - 3:00 PM

Seminar 20 (Intermediate)

Practical Aspects of Incorporating Occupant Considerations into Building Design and Operations

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A302

Sponsor: MTG.OBB Occupant Behavior in Buildings

Chair: Julia Day, Ph.D., Associate Member, Washington State University, Pullamn, WA

While occupants are emerging as a significant source of building performance uncertainty, they are largely neglected in the design process. Many lessons can be learned from occupants in existing buildings via occupant surveys, data collection and model development. Yet there are few precedents to improve future buildings. This seminar focuses on methods and case studies whereby occupants are a more central consideration for new building design and improving existing buildings operations. The scope ranges from fundamental research on incorporation of occupants into simulation-aided design to case studies and postoccupancy evaluations with occupant-centric controls.

1. Quantifying the Impact of Occupant Behavior on Savings of Energy Conservation Measures

Kaiyu Sun, Member, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Occupant Centered Controls

Jose Vazquez-Canteli, The University of Texas at Austin, Austin, TX

3. Occupant Behavior in Building Design Codes and Standards

Mohamed Ouf, Ph.D., Member, Carleton University, Ottawa, ON, Canada

4. A Case Study: Assessing Occupants' Understanding of Building Controls in High Performance Buildings

Julia Day, Ph.D., Associate Member, Washington State University, Pullamn, WA

1:30 PM - 3:00 PM

Seminar 21 (Intermediate)

Uncertainties in Compressor Performance and Field Performance of Liquid-Chilling Systems

Track: Systems and Equipment

Room: Building A, A404

Sponsor: 8.2 Centrifugal Machines

Chair: Justin Prosser, P.E., Member, AHRI, Arlington, VA

Two major drivers influence the HVACR industry today: climate change and minimum efficiency regulations. As these sometimes complementing items shape the future of HVACR products, it is important to consider the reality of performance uncertainty in these products, specifically that of compressors (components) and liquid chillers (systems) when installed in the field. This seminar focuses on the test measurement uncertainty of compressor performance and field performance of liquid chilling systems and suggest possible solutions to the challenges these uncertainties cause for both HVACR manufacturers and users.

1. Uncertainties in Compressor Performance

Justin Prosser, P.E., Member, AHRI, Arlington, VA

2. An Introduction to Field Testing of Liquid Chillers and ASHRAE Standard 184

Ian Spanswick, O2RC Solutions LLC, York, PA

1:30 PM - 3:00 PM

Workshop 3 (Basic)

Room Loads to Equipment Sizing Missing Link: How Can ASHRAE Help Young Engineers?

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: 4.1 Load Calculation Data and Procedures

Chair: Larry Sun, Member, Independent Consultant, Huntington Beach, CA

This workshop helps ASHRAE and TC4.1 understand what knowledge gaps exist for young engineers between load calculations and equipment selection. No ASHRAE standard or guideline exists to help engineers navigate from the calculated room loads to the equipment selections. As more experienced engineers retire, it can be a challenge for young engineers to understand how to connect the dots between loads and equipment. Elements considered in the loads to equipment selection process vary widely by region, climate type and firm. This workshop provides needed input to judge what additional standards or guidelines are needed, particularly for young engineers.

1. What We Learned from the Houston Workshop

Rachel Spütler, Cyntergy, Tulsa, OK

2. The Atlanta Workshop: An Interactive Survey

James Pegues, Member, Carrier UTC, Syracuse, NY

Sunday, January 13, 3:15 PM - 4:45 PM

Seminar 22 (Intermediate)

Building Energy Storage: The Future of the Smart Grid

Track: Renewables and Natural Systems

Room: Building A, A410

Sponsor: 6.9 Thermal Storage

Chair: Chris Mincey, P.E., Associate Member, Crom LLC, Gainesville, FL

As reliance on solar and wind generation continues to increase, the electrical grid must rapidly change to incorporate these new intermittent renewable resources. In order to maximize the benefit of these intermittent resources, storage must be a part of the future smart grid. This seminar discusses the integration of energy storage within buildings in order to maximize the benefit of renewables for both the grid and building owners alike.

1. Unique Building Applications of Ice and Chilled Water Thermal Energy Storage

Guy S. Frankenfield, P.E., Member, DN Tanks, Grand Prairie, TX

2. Batteries are Magic Boxes: Can They Actually Deliver All They Slated To?

Ram Narayanamurthy, P.E., Associate Member, Electric Power Research Institute, Palo Alto, CA

3. Building Energy Storage: A Vital Component in a Low Carbon Future

Mark MacCracken, P.E., Member, CALMAC Corp, Fair Lawn, NJ

Monday, January 14

8:00 AM - 9:30 AM

Technical Paper Session 2 (Intermediate)

Studies in Energy Efficiency

Track: Renewables and Natural Systems

Room: Building A, A408

Chair: Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

Driving towards energy efficiency, this session highlights recent studies in energy efficient technologies. From solar panels to motor design learn about new technical advances in energy efficient system components.

1. A Comparison of the Annual Energy Use of Fixed and Variable Airflow Parallel Fan-Powered Terminal Units in a Small Office Building (AT-2019-004)

Dennis O'Neal, Ph.D., P.E., Fellow ASHRAE, Baylor University, Waco, TX

2. Effects of System Materials towards the Breakdown of Lubricants and Low GWP Refrigerants (RP-1774) (AT-2019-005)

Ngoc Dung (Rosine) Rohatgi, Ph.D., Member, Spauschus Associates Inc., Sylva, NC

3. Performance Evaluation of a 3-Fluid Membrane Liquid Desiccant Air-Conditioning System (WITHDRAWN)

Devin Storle, Saskatoon, SK, Canada

4. Seasonal Solar Energy Storage Technologies in Buildings (AT-2019-006)

Uros Stritih, Univerza v Ljubljani Fakulteta za Strojninstvo, Ljubljana, Slovenia

8:00 AM - 9:30 AM

Conference Paper Session 7 (Intermediate)

Air Distribution Strategies

Track: Systems and Equipment

Room: Building A, A405

Chair: Samir Traboulsi, P.Eng., Fellow Life Member, Thermotrade/Ranec, Beirut, Lebanon

People are spending an increasing amount of time in indoor spaces and air quality is a major concern in design. From new sensors to air distribution, the air we breathe inside buildings must be designed correctly. This session highlights strategies for maintaining good indoor air quality for occupied spaces.

1. Photocatalytic Activity and Durability of Commercial TiO₂ Photocatalysts for Indoor Air Purification (AT-2019-C022)

Alireza Haghghatmamaghani, Student Member, Chang-Seo Lee, Ph.D., Associate Member and Fariborz Haghghat, Ph.D., Fellow ASHRAE, Concordia University, Montreal, QC, Canada

2. Capabilities and Limitations of Commercially Available Wireless Indoor Environment Sensors (AT-2019-C023)

Angelos Mylonas, Bjarne Olesen, Ph.D., Presidential Member, Ongun Kazanci, Ph.D., Associate Member and Rune Andersen, International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

3. Temporal Variations in Estimated Ventilation and Relative Performance Based on Continuous CO2 Monitoring in Offices (AT-2019-C024)

Samy Clinchard¹, Tomas Novotny, P.Eng., Member¹, Rick Aller¹, Salvatore della Vecchia¹ and Ulla Haverinen-Shaughnessy², (1)720 Degrees Ltd, Helsinki, Finland, (2)720 Degrees Ltd, New York, NY

4. Comparing Configurations for Supply and Return Vents in Mixed Air Distribution Systems to Reduce Micro-particle Indoor Concentrations (AT-2019-C025)

Walid M. Chakroun, Ph.D., Fellow ASHRAE¹, Kamel Ghali, Ph.D.², Nesreen Ghaddar, Ph.D., Member² and Soroor Alotaibi, Member¹, (1)Kuwait University, Kuwait City, Kuwait, (2)American University of Beirut, Beirut, Lebanon

8:00 AM - 9:30 AM

Conference Paper Session 8 (Intermediate)

Quality Office Conditions through HVAC and R

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A404

Chair: Jaya Mukhopadhyay, Ph.D., Member, Montana State University, Bozeman, MT

Thermal comfort and indoor air quality are two key components of quality conditioned spaces. We all want to work in those conditions, but how are they achieved? Listen to presentations on methods of improving thermal comfort and creating quality conditioned spaces.

1. Restoring Trust: How Building Automation, Operators and Tenants Restored Indoor Environmental Conditions Following Failed Improvement Measures (AT-2019-C026)

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

2. The Convergence of ASHRAE Standards 90.1, 62.1 and 55: Energy Efficiency Measures and an Example of an Office Building (AT-2019-C027)

Chonghui Liu, P.E., Member, IPD Engineering, Syracuse, NY

3. Indoor Air Quality and Energy Efficiency (AT-2019-C028)

Nirmal Ram D, Cerebration Consultants, Bengaluru, India

4. Performance Evaluation of Active Chilled Beam in Real Office Conditions in a High-Performance Building in Heating (AT-2019-C029)

Rohit Upadhyay, Student Member and Dr. Rodrigo Mora, P.Eng., Member, British Columbia Institute of Technology, Burnaby, BC, Canada

8:00 AM - 9:30 AM

Seminar 23 (Advanced)

Advances in Low-GWP Refrigeration System Architectures

Track: Refrigeration

Room: Building A, A410

Sponsor: 10.7 Commercial Food and Beverage Refrigeration Equipment, Refrigeration Committee

Chair: Georgi Kazachki, Ph.D., Fellow ASHRAE, Dayton Phoenix Group, Inc., Dayton, OH

The seminar introduces new refrigeration system architectures in line with the new design trends aiming at reducing the refrigerant charge, increase in energy efficiency, and extending the temperature application range

1. Micro-Distributed Systems

Timothy Anderson, Hussmann, Bridgeton, MO

2. Application of CO2 Transcritical Advanced Technologies in Hot Climates

Shitong Zha, Ph.D., Member, Heatcraft, Stone Mountain, GA

3. Combining HFO's with Various System Architectures to Reduce Energy Use and Emissions in Commercial Refrigeration

Gustavo Pottker, Member, Honeywell - Buffalo Research Laboratory, Buffalo, NY

8:00 AM - 9:30 AM

Seminar 24 (Intermediate)

ASHRAE Thermal Guidelines Driving Data Center Performance & Innovation

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A305

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

Chair: Joseph Gangemi, Life Member, Northern Air Systems, Rochester, NY

The Thermal Guidelines can have a positive impact on global data center construction and operations. Outcomes show how when the Thermal Guidelines are applied innovatively, reliability and availability (the number data center customer requirement) can be complementary to both energy-efficiency and sustainability. In addition, such an approach can also reduce both data center project capital expenditure and operational expenditure through-out the life cycle of the building. This session details the ASHRAE thermal guidelines, their application to enable free cooling for a new UK facility, and closes with how the concept was validated a priority.

1. The Real Opportunity of the Thermal Guidelines and their Impact on IT Equipment Design

Dustin Demetriou, Ph.D., Member, IBM, Poughkeepsie, NY

2. Data Center Site Selection, Business Decisions and Thermal Guidelines that Facilitate the Bold Decision to Enter the Wholesale Market and Adopt a Free Cooling Strategy

Paul Finch, CEng, Member, Kao Data, London, United Kingdom

3. Validating the Design Concept for a Data Center Without Mechanical Cooling in the Southern UK

Mark Seymour, CEng, Member, Future Facilities Ltd, London, United Kingdom

8:00 AM - 9:30 AM

Seminar 25 (Basic)

Ground Source Heat Pumps: You Can't Always Get What You Want

Track: Common System Issues and Misapplications

Room: Building A, A302

Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: Michael Kuk, Member, CERx Solutions, LLC, Oswego, IL

This session presents multiple examples of how you (the designer) don't get what you always want. Just because a system is designed well or with good intention does not mean that it gets built or operated the way you intended. The seminar also presents examples of projects that didn't meet the design intent because the system wasn't initially commissioned, or properly constructed, operated or maintained. Or they didn't follow sound engineering principles. Examples of how to avoid these pitfalls are presented, along with good solutions and good examples.

1. Well You Just Might Find (Through Commissioning) That You Didn't Get You Need

Michael Kuk, OPMP, CPMP and BEAP, Member, CERx Solutions, LLC, Oswego, IL

2. But if You Try... You Get What You Need

Stephen Kavanaugh, Member, University of Alabama, Northpoint, AL

3. Burying Mistakes

Lisa Meline, P.E., Member, Meline Engineering Corporation, Sacramento, CA

8:00 AM - 9:30 AM

Seminar 26 (Basic)

Load Calculation Considerations for Radiant Systems

Track: HVAC&R Fundamentals and Applications

Room: Building A, A301

Sponsor: 4.1 Load Calculation Data and Procedures

Chair: Rachel Spitler, Associate Member, Cyntergy, Tulsa, OK

Radiant systems have different cooling load characteristics than all-air systems, but most load calculations methodologies are designed for all-air systems. This session discusses elements considered in radiant system load calculations, the problems with designing radiant systems using all-air system methods, review results from two recent radiant system research projects and present a design tool for radiant system load calculations.

1. A Side-by-Side Laboratory Comparison of Peak Space Cooling Loads and Daily Thermal Energy Use for Radiant and All-air Systems

Jonathan Woolley, University of California, Berkeley, Berkeley, CA

2. Difference in Cooling Loads for Radiant and All-Air Systems for Different Load Scenarios

Ardeshir Moftakhari, Student Member, University of Texas, Austin, TX

3. What Happens when Radiant Systems are Designed by Methods Developed for All-air Systems?

Atila Novoselac, Ph.D., Member, University of Texas at Austin, Austin, TX

4. Development and Demonstration of an Interactive Web-based Design Tool for High Thermal Mass Radiant Cooling Systems

Carlos Duarte, University of California, Berkeley, Berkeley, CA

Monday, January 14, 9:45 AM - 10:45 AM

Conference Paper Session 9 (Intermediate)

Ground Source Heat Pumps, from Experimental Applications to Novel Case Studies

Track: Renewables and Natural Systems

Room: Building A, A408

Chair: Peng Yin, Ph.D., Associate Member, University of Louisiana at Lafayette, Lafayette, LA

Ground source heat pumps area common technology employed for hydronic systems. Come learn about new experimental methods in GSHP system design and case studies highlighting successful application of novel systems.

1. Experimental and Simulation Studies on Solar-Ground Source Heat Pump System (AT-2019-C030)

Eikichi Ono, M.D.¹, Masaki Shioya, Ph.D.¹, Taizo Shimo, M.D.¹ and Yoshiro Shiba, Ph.D.², (1)Kajima Technical Research Institute, Tokyo, Japan, (2)Zeneral Heatpump Industry Co.,Ltd., Nagoya, Japan

2. Modeling and Parametric Study of Large Diameter Shallow Bore Helical Ground Heat Exchanger (AT-2019-C031)

Antash Najib, Student Member¹, Angelo Zarrella², Curtis Harrington, P.E.¹, Peter Grant³, Rachael Larson¹ and Vinod Narayanan¹, (1)University of California, Davis, CA, (2)University of Padova, Padova, Italy, (3)Frontier Energy, Davis, CA

3. Strategies and Lessons Learned for Optimal Performance of Gas Heat Pump-Driven Residential Combination Space and Water Heating Systems (AT-2019-C032)

Paul Glanville, P.E., Associate Member¹, Aleksandr Fridlyand, Ph.D., Member¹, Chris Keinath, Ph.D., Member² and Michael Garrabrant, Member³, (1)Gas Technology Institute, Des Plaines, IL, (2)Stone Mountain Technologies, Inc., Johnson City, TN, (3)Stone Mountain Technologies, Inc., Erwin, TN

9:45 AM - 10:45 AM

Conference Paper Session 10 (Intermediate)

Human Factors Design for Residential Buildings

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A303

Chair: David Yashar, Ph.D., P.E., Member, National Institute of Standards and Technology, Gaithersburg, MD

Increasing efficiency of residential buildings has created challenges for the design professional with respect to human comfort. Creating high performing residential buildings also creates the long term challenge of performance over time. This session discusses how performance changes over time and how to navigate the unintended consequences of high performing residential buildings.

1. Human Factors of High Performance Multifamily Housing (AT-2019-C033)

Philip Agee, Student Member¹, Andrew McCoy, Ph.D.¹, Brian Kleiner, Ph.D.¹, Dong Zhao, Ph.D.², Frederick Paige, Ph.D.¹ and Georg Reichard, Ph.D., Member¹, (1)Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Michigan State University, East Lansing, MI

2. Energy Savings Estimates for Occupancy- and Temperature-based Smart Ventilation Control Approaches in Single-family California Homes (AT-2019-C034)

Jordan Clark, Ph.D., Member¹, Brennan Less², Iain Walker, Ph.D., Fellow ASHRAE², Max Sherman, Ph.D., Fellow ASHRAE², Spencer Dutton, Ph.D.² and Xiwang Li, Ph.D.², (1)The Ohio State University, Columbus, OH, (2)Lawrence Berkeley National Laboratory, Berkeley, CA

3. Next-Generation Residential Space Conditioning System for California (AT-2019-C035)

Sara Beaini, Ph.D., Member¹, Ammi Amarnath¹, Curtis Harrington, P.E.², Mark Modera, Ph.D., P.E., Fellow ASHRAE², Morton Blatt, Fellow ASHRAE¹, Robert Davis, P.E., Member³, Ron Domitrovic, Ph.D., Member⁴, Ryohei Hinokuma⁵, Sreenidhi Krishnamoorthy, Ph.D., Student Member² and Walter Hunt, Member⁴, (1)Electric Power Research Institute, Palo Alto, CA, (2)University of California, Davis, CA, (3)PG&E Applied Technology Services (formerly), San Ramon, CA, (4)Electric Power Research Institute, Knoxville, TN, (5)Daikin US Corporation, Irvine, CA

9:45 AM - 10:45 AM

Seminar 27 (Intermediate)

Cannabis Grow Facilities: Challenges for HVAC Design, Equipment Selection and Operation

Track: Systems and Equipment

Room: Building A, A405

Sponsor: 1.5 Computer Applications

Chair: Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

The legalization of cannabis in many US states and Canada is providing a unique growth opportunity for the HVAC industry. Grow facilities that focus on cannabis require exacting and specific air conditions that differ from conventional HVAC systems. The first presentation discusses how HVAC cooling and heating load calcs and equipment selection differ for grow facilities versus conventional HVAC applications. The seminar discusses all of the additional parameters required to properly calculate cooling, heating, and humidification loads and the resulting equipment selection. The second presentation in the seminar discusses real world applications.

1. Specialized HVAC Load Calcs and Equipment Selection for Grow Facilities

Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

2. Cannabis Grow Facilities: Challenges for HVAC Design and Operation

Bruce Straughan, P.E., Member, Straughan Forensic, LLC, Arvada, CO

9:45 AM - 10:45 AM

Seminar 28 (Intermediate)

Challenges of Using Open Source CFD Tools

Track: HVAC&R Fundamentals and Applications

Room: Building A, A404

Sponsor: 4.10 Indoor Environmental Modeling

Chair: Mike Koupriyanov, P.E., Associate Member, Price Industries Limited, Winnipeg, MB, Canada

Computational Fluid Dynamics (CFD) has been rapidly catching on as an invaluable tool for indoor airflow analysis. Practitioners eventually face a choice between using commercial or open-source CFD software. Open-source CFD packages are an attractive option due to their affordability and ever-increasing capabilities. Potential drawbacks are their accuracy and the relatively steep learning curve that goes along with any open source software platform. This session will showcase several open source CFD tools for various indoor airflow and contaminant modeling applications. Comparisons to commercial CFD packages will be made and the return on investment of open source tools will be evaluated.

1. Fast Fluid Dynamics for Energy Efficient Building Design and Operation

Wangda Zuo, Ph.D., Member, University of Colorado Boulder, Boulder, CO

2. The Return on Investment: Modeling a Commercial Kitchen with Open CFD Tools

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

3. Assessment of the CFD-0 module of CONTAM for Airborne Contaminant Transport Modeling in Hospital and Laboratory Applications

Bruno Perazzo Pedrosa Barbosa, FIOCRUZ, Rio de Janeiro, Brazil

9:45 AM - 10:45 AM

Seminar 29 (Intermediate)

Cutting-Edge Japanese Technologies SHASE Annual Award for ZEB Constructions in 2018

Track: Renewables and Natural Systems

Room: Building A, A410

Sponsor: MTG.ACR, 9.10 Laboratory Systems, 9.11 Clean Spaces

Chair: Shin-ichi Tanabe, Ph.D., Fellow ASHRAE, Department of Architecture, Waseda University, Tokyo, Japan

Two ZEBs, featuring a renewable and natural system with a SHASE Technical Award, are introduced. One is a city hall which achieved "Nearly ZEB" with groundwater and woody biomass hot water for desiccant and radiant air-conditioning. This all-renewable energy system covers 53.4% of the annual heating/cooling load. Another is a ZEB renovation of occupied buildings which achieved positive energy balance after retrofitting while people are working inside. Major measures include: geothermal air-conditioning, solar heating, natural ventilation, desiccant units for intake air and PV and Wellness Control System. Energy reduction of 71% and PV created a Positive Energy Building (PEB).

1. ZEB City Hall Encompasses Regional History, Climate and Resources in Japan

Tomohisa Takebe, NIHON SEKKEI, INC., Tokyo, Japan

2. ZEB Renovation of Building in Actual Use

Hiroki Kawakami, Member, Takenaka Corporation, Tokyo, Japan

9:45 AM - 10:45 AM

Seminar 30 (Intermediate)

Hydronics Gone Haywire: What the Gen Xers and Baby Boomers Have Done Wrong: The Sequel

Track: Common System Issues and Misapplications

Room: Building A, A301

Sponsor: 6.1 Hydronic and Steam Equipment and Systems

Chair: Jessica Mangler, P.E., Member, Affiliated Engineers, Inc., Seattle, WA

This session is ideal for YEA members and other designers so they do not repeat common mistakes and misapplications that the Gen Xers and Baby Boomers have made in the past. In this seminar, the audience will help to identify common mistakes and misapplications in hydronic heating and cooling systems. Following the identification of the problem, the presenters will share mitigation techniques and discuss design methods used in the past to overcome the identified issues.

1. Chilled and Condenser Water System Misapplications and Mitigation

Michael Schwedler, Member, Trane, La Crosse, WI

2. Heating Water System Misapplications and Mitigation

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

9:45 AM - 10:45 AM

Seminar 31 (Intermediate)

Thermodynamic Analysis of Non-Vapor-Compression Cooling/Heating Technologies

Track: HVAC&R Fundamentals and Applications

Room: Building A, A302

Sponsor: 1.1 Thermodynamics and Psychrometrics

Chair: Zhiwei 'Joy' Huang, Ph.D., Member, Johnson Controls, Norman, OK

This seminar focuses on non-vapor-compression (i.e. not-in-kind) HVAC technologies. This session first provides an overview of various not-in-kind technologies, including magneto-chloric, elastic-chloric and absorption based systems. This overview focuses on fundamental analysis based on first and second law of thermodynamics and performance comparison with vapor compression systems. Then two most promising technologies elastocaloric cooling and magnetocaloric cooling are discussed in detail separately. Fundamental theory are proposed and experimental data are presented. Overall, this session provides the audience a basic idea of non-vapor-compression technology potentials.

1. Thermodynamic Analysis of NIK Cooling/Heating Technologies

Kashif Nawaz, Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Regenerative Elastocaloric Cooling

Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

3. Efficiency Benefit of Magnetocaloric Cooling Systems under Part Load Operation

Suxin Qian, Ph.D., Member, Xi'an Jiaotong University, Xi'an, China

9:45 AM - 10:45 AM

Forum 1 (Advanced)

What Do We Know about Contaminant Generation Rates?

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A305

Sponsor: 7.6 Building Energy Performance

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

Concentration levels of contaminants within the occupied spaces determine the indoor air quality. Several factors can affect these concentration levels including the sources of contaminants, their generation rates, location, strength and the ventilation effectiveness of the HVAC system. Do we really know the generation rates of contaminant in the indoor spaces? How can those be measured and monitored? Do the supply airflow rate specifications account for the generation rates? This session brainstorms these questions and will attempt to identify current state of the art about the contaminant generation rates. Active participation is required from the attendees.

11:00 AM - 12:00 PM

Conference Paper Session 11 (Intermediate)

Equipment Component Design for Enhanced Operation

Track: Systems and Equipment

Room: Building A, A408

Chair: Bass Abushakra, Ph.D., Member, United States Military Academy, West Point, NY

This session highlights advances in system components for improved equipment operation. From nozzles to specialty coatings, new concepts are discussed, highlighting operational advantages from their use. Participants will walk away with an understanding of the improvements available and advantages from these new technologies.

1. Design of Multi Nozzles for a Portable Air Flow Meter using Numerical Simulation (AT-2019-C036)

Sang Taek Oh, Ph.D., Member¹, Jong Jun Park, Student Member², Sean Hay Kim, Ph.D., Member² and Young Il Kim, Ph.D., P.E., Member², (1)Seoul Industry Engineering Co., Ltd., Seoul, Korea, Republic of (South), (2)Seoul National University of Science and Technology, Seoul, Korea, Republic of (South)

2. Effect of Mixed Super-Hydrophilic and Super-Hydrophobic Surface Coatings on Droplets Freezing and Subsequent Frost Growth During Air Forced Convection Channel Flows (AT-2019-C037)

Ellyn Harges, Student Member, Lorenzo Cremaschi, Ph.D., Member, Amy Strong, Student Member and Burak Adanur, Student Member, Auburn University, Auburn, AL

3. Optimization of Microchannel Shape Using Analytical Models for Condensation (AT-2019-C038)

Khoudor Keniar, Student Member and Srinivas Garimella, Georgia Institute of Technology, Atlanta, GA

11:00 AM - 12:00 PM

Conference Paper Session 12 (Intermediate)

Equipment in Air Distribution

Track: Systems and Equipment

Room: Building A, A303

Chair: Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

Air distribution is an important factor in HVAC system design. This session covers methods of measurement to assure proper operation and components used for air distribution.

1. Improving Effective Energy-Efficient Commercial Package Dedicated Outside Air Systems Located in Hot-Humid Climate Zones (AT-2019-C039)

Charles Withers Jr.¹ and David Salyer², (1)Florida Solar Energy Center, Cocoa, FL, (2)Addison, Orlando, FL

2. In-Situ Observations of Series and Parallel Fan Powered Terminal Units (AT-2019-C040)

John Bryant, Ph.D., P.E., Member¹ and Basel Kanaan², (1)Texas A&M University, College Station, TX, (2)Grant, Inc., Dallas, TX

3. Development and Calibration of an Online Energy Model for AHU Fan (AT-2019-C041)

Jin Dong, Member¹, Jeffrey Munk, Member¹, Piljae Im, Ph.D., Member¹, Sen Huang, Student Member², Teja Kuruganti¹ and Yan Chen², (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)Pacific Northwest National Laboratory, Richland, WA

11:00 AM - 12:00 PM

Seminar 32 (Intermediate)

Cutting-Edge Japanese Technologies SHASE Annual Award for New Constructions in 2018

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A302

Sponsor: 7.6 Building Energy Performance

Chair: Shinsuke Kato, Ph.D., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan

We introduce two buildings in Tokyo having earned the SHASE Technical Award for achieving energy efficiency and comfort. One is an office building featuring "radiant ceiling air-conditioning with slight air flow" and "medium-temperature chilled/warm water for air-handling units". Energy saving of 63% was realized, which also earned it the ASHRAE Technology Awards 2017 First Place. Another is a high-rise hospital, also featuring "radiant ceiling air-conditioning for all patients' rooms", plus an "odor sensor-based ventilation-control system" that successfully reduced the volume of intake outdoor fresh air. Energy saving of 32% was achieved with the LEED-HC v2009 Gold.

1. Practice of an Environmental Facility Plan for a New Construction Building

Taro Hongo, Member, NIKKEN SEKKEI LTD., Tokyo, Japan

2. Creation of Urban High-rise Hospitals through Medical and Architectural Collaboration

Koichi Machida, Shimizu Corporation, Tokyo, Japan

11:00 AM - 12:00 PM

Seminar 33 (Basic)

Low GWP Refrigerants: Components and System Designs

Track: Refrigeration

Room: Building B, B313a

Sponsor: 8.4 Air-to-Refrigerant Heat Transfer Equipment, 8.1 Positive Displacement Compressors

Chair: Pega Hrnjak, Ph.D., Fellow ASHRAE, University of Illinois, ACRC and CTS, Urbana, IL

This seminar focuses on low GWP refrigerants and the methodology of adopting them in system design. The performances of a variety of lower GWP alternatives at various temperatures are presented. The design method of compressors is also included.

1. Evaluation of Alternative Lower GWP Refrigerants

Paul de Larminat, Ph.D., P.E., Member, Johnson Controls Industries, York, France

2. Development of a Light-commercial Hot-gas Bypass Load Stand for Accelerated Compressor Development

Craig Bradshaw, Ph.D., Member, Oklahoma State University, Stillwater, OK

11:00 AM - 12:00 PM

Seminar 34 (Intermediate)

Modeling MegaStructures, Arena, etc.

Track: The Engineer's Role in Architecture

Room: Building A, A404

Sponsor: 4.10 Indoor Environmental Modeling

Chair: Duncan Phyfe, Associate Member, Alden, Holden, MA

Computational Fluid Dynamics (CFD) will accurately model "Mega Structures". The engineer can take advantage of the ability of CFD to accurately solve a wide range of applications in support of today's designs. We will look at two very different applications but each sharing the critical need to show accurate solar loading in their analysis. The first analysis will look at a semi-transparent photovoltaic installation; successfully reducing the heating cost in an automotive tunnel. The second analysis will look at conditioning strategies for tall, open spaces with large solar loads. The atrium includes displacement ventilation and an active radiant slab.

1. Modeling of Road Tunnel with Semi-transparent Photovoltaic (STPV) Installed at Tunnel Approaches

Liangzhu (Leon) Wang, Concordia University, Montreal, QC, Canada

2. Conditioning Strategies for Tall Open Spaces with Large Solar Loads

Mike Koupriyanov, P.E., Associate Member, Price Industries Limited, Winnipeg, MB, Canada

11:00 AM - 12:00 PM

Seminar 35 (Intermediate)

NetZero: Understanding, Reducing, and Mitigating Uncertainty in the Design Phase

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A405

Sponsor: 7.6 Building Energy Performance

Chair: Brenda Morawa, P.E., Member, IES, LTD, Atlanta, GA

Understanding different types of simulations and the usage of each is critical to designing and operating high performance buildings. When utilizing simulation to demonstrate code or above code performance, standard occupancy profiles and miscellaneous unregulated loads are acceptable and lead to satisfactory decisions. However, as we pursue net zero and regenerative design and operations, understanding and quantifying the impact of these loads and their relationship to thermal comfort and IAQ parameters becomes much more significant. This session explores ways to understand and mitigate the uncertainty leading to better design and operation of high performance buildings.

1. Design Phase Modeling: Unregulated Uncertainties in the Path to Net Zero

Abigail Hampsmire, P.E., Member, Green Business Certification Inc., Washington, DC

2. NetZero: Best and New Practices to Reduce Uncertainty in the Design Phase Simulations

Brenda Morawa, P.E., HBDP, Member, Vice President, North America, Atlanta, GA

11:00 AM - 12:00 PM

Seminar 36 (Basic)

Pairing Geothermal and Hydronic Systems in Residential Buildings

Track: Systems and Equipment

Room: Building B, B313b

Sponsor: 6.1 Hydronic and Steam Equipment and Systems

Chair: David Lee, P.Eng., Member, Armstrong Fluid Technology, Toronto, ON, Canada

This seminar provides design tools and tips for residential buildings utilizing a ground-source heat pump paired with hydronic heating and cooling system. A cutting-edge design example for a home currently constructed in Northern California is the basis of the seminar. Presenters will review the load calculations and sizing of the ground-loop heat exchanger and hydronic piping design. Combining sound piping strategies, proper air management, and latest pump technology with simple design and control approaches can improve overall system efficiencies. References to applicable sections of ASHRAE 90.2 will be included in the design considerations.

1. Ground-Source Heat Pump Design for a Moderate Residence in Northern California

Lisa Meline, P.E., Member, Meline Engineering Corporation, Sacramento, CA

2. Energy Efficient Residential Hydronic System Design

Stan Kutin, Member, Xylem Bell & Gossett, Morton Grove, IL

11:00 AM - 12:00 PM

Seminar 37 (Intermediate)

Space Pressurization for Infection Control and Hospital Accreditation

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A305

Sponsor: 1.4 Control Theory and Application

Chair: Chad Moore, P.E., Member, Engineering Resource Group, Jackson, MS

To maintain accreditation, the operations staff in a hospital has to maintain and demonstrate performance of the HVAC systems that pressurize critical spaces. Success starts with mechanical design principles and continues through construction and commissioning. Finally, it persists in a formal, documented performance monitoring program. This session explains physical aspects of pressurization, analyzes design approaches and design decisions. Finally, it presents the ideas and execution of a monitoring and maintenance program that supports infection control and accreditation.

1. Controlling Contaminants with Space Pressurization

James Coogan, P.E., Associate Member, Siemens Building Technologies, Chicago, IL

2. Creating a Program to Identify and Monitor Pressurized Spaces in a Hospital

Dennis Ford, Atrium Health, Charlotte, NC

11:00 AM - 12:00 PM

Seminar 38 (Intermediate)

Tall Space Load Calculations

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: 4.1 Load Calculation Data and Procedures

Chair: Jingjuan (Dove) Feng, Ph.D., Associate Member, Taylor Engineering, Alameda, CA

Tall spaces are a load calculation challenge since the normal ASHRAE load calculations assumption of a well-mixed space does not apply to tall spaces such as an atrium, a gather hall or an airport, where it is not necessary to condition the space above the occupied height. This session examines case studies of tall space load calculations and the benefits of using CFD, computational fluid dynamics.

1. Using Physics to Conserve Energy

Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems Analytics LLC, Marina Del Rey, CA

2. Load Estimation for Tall Spaces using Computational Fluid Dynamics

Dan Nall, AIA, Fellow ASHRAE, Syska Hennessy, New York, NY

11:00 AM - 12:00 PM
Workshop 4 (Basic)

Getting Involved with ASHRAE Standards

Track: HVAC&R Fundamentals and Applications

Room: Building A, A301

Sponsor: 7.6 Building Energy Performance

Chair: Walter Grondzik, P.E., Fellow Life Member, Ball State University, Muncie, IN

The ASHRAE standards process can seem complex and opaque from the outside. However, getting involved with this process as a member of a standards project committee or as a reviewer/commenter is relatively easy. This session provides an overview of the ASHRAE standards process, with specific advice on getting involved. Questions are welcomed and encouraged.

1. Getting Involved with ASHRAE Standards

Walter Grondzik, P.E., Fellow Life Member, Ball State University, Muncie, IN

2:15 PM - 3:45 PM
Seminar 39 (Basic)

How Revisions to ASHRAE Standard 180 will Help Improve Maintenance Services

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B313a

Sponsor: 7.3 Operation and Maintenance Management

Chair: Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

News Flash: BSR/ASHRAE/ACCA Standard 180, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems, has been updated and published in 2018. This seminar explores the updates to Standard 180-2018.

4. How ASHRAE Standard 180 Can Transform the HVAC Maintenance Industry

Kristin Heinemeier, University of California, Berkeley, Davis, CA

2. Western HVAC Performance Alliance Inc. (WHPA) Use of ASHRAE Standard 180

Richard Danks, P.E., Member, Cleveland, OH

1. ASHRAE Standard 180 Use and Updates

Tom Paxson, P.E., Life Member, Pax-Sun Engineering, Inc., Lufkin, TX

3. Operations and Maintenance Programs Using ASHRAE Standard 180: A Factor for Persistence in Building Energy Performance

Cedric Trueman, P.Eng., Life Member, Trueman Engineering Services, Victoria, BC, Canada

2:15 PM - 3:45 PM
Seminar 40 (Basic)

Update on Global Policies and Programs for Best Use of Refrigerants

Track: Refrigeration

Room: Building B, B313b

Sponsor: 7.3 Operation and Maintenance Management

Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

Fluorinated gases are used in refrigeration and air-conditioning applications worldwide and contribute to global warming. The Montreal Protocol was extended to control the production and consumption of HFCs in the Kigali Amendment. EU adapted new F-gas Regulation from 2015. As switching of high GWP refrigerants to low GWP and confining refrigerants within the system become important, UN, IIR, US and EU are striving their efforts. UN Environment OzonAction promotes proper refrigerant management in developing countries. The US DOE directs building energy consumption reductions. This session provides updates on global refrigerant regulations and efforts to best use of refrigerants throughout lifetime.

1. An Overview of Refrigerants Related Policies in Article 5 Countries and UN Environment Partnerships to Support Compliance with the Protocol

Ayman Eltalouny, UN Environment, Manama, Bahrain

2. The Application of the EU F-Gas Regulations: An Example for Other Regions?

Didier Coulomb, International Institute of Refrigeration, Paris, France

3. IIR Actions to Reduce Refrigerant Emissions

Didier Coulomb, International Institute of Refrigeration, Paris, France

4. US GHG Regulation and EERE Program Update

Antonio Bouza, U.S. Department of Energy, Columbia, MD

2:15 PM - 4:15 PM
Workshop 5 (Basic)

Best Practices of the Mentor-Mentee Relationship

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: College of Fellows, YEA Committee

Chair: Jacob Kopocis, Member, Control Services, Inc, Omaha, NE

Mentoring can be a powerful resource and create mutually beneficial relationships for the mentor and mentee. ASHRAE members at any stage of their career will benefit from having access to a fellow member as they work through a challenging or demanding project, move into a new role, or seek a trusted advisor relationship for a prolonged period of time. This mentorship workshop is meant to be an interactive experience to kickstart the ASHRAE mentorship program among all attendees.

1. Best Practices of the Mentor-Mentee Relationship

Ralph Kison, Member, Kison, Inc., Vancouver, BC

Monday, January 14, 4:00 PM - 5:00 PM
Seminar 41 (Intermediate)

Assessing the Effectiveness of Economizers for De-Centralized Cooling Systems

Track: Systems and Equipment

Room: Building B, B313a

Sponsor: 9.8 Large Building Air-Conditioning Systems

Chair: William Artis, Member, Essential Energy Consulting LLC, Hicksville, NY

As standards and energy codes become more stringent in their requirements for economizers, designers are faced with incorporating these requirements into their design in ways that are both practical and cost effective. Differences in compliance paths often lead to confusion during design, and it is unclear to what extent the prescriptive economizer requirements are effective. This seminar reviews current energy code adoptions and their requirements for economizers, discuss design challenges as they pertain to different cooling system types, review the effectiveness of economizers based on system type, building and application and assess potential heat recovery benefits.

1. Applying Economizers to De-centralized Systems

Jonathan Johrden, P.E., Member, JDJ Engineering, New York, NY

2. Economizer Energy Performance and Cost Benefit Analysis

Sam Mason, P.E., Member, Encompass Energy LLC, Denver, CO

4:00 PM - 5:00 PM
Seminar 42 (Intermediate)

Using Air to Air Energy Recovery to Help Balance Comfort, IAQ and Energy

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B313b

Sponsor: 5.5 Air-to-Air Energy Recovery

Chair: Ronnie Moffitt, P.E., Member, Ingersoll Rand, Lexington, KY

Air to Air Energy Exchangers can be applied to traditional HVAC systems. To do so there is a balance between utilizing existing cooling equipment and air to air energy exchangers that will physically fit and function as desired. This seminar examines several examples of finding this balance to help achieve comfort, IAQ and energy saving goals

1. Wraparound Heat Pipe Technology: Using Heat Pipes to Save Energy and Improve IAQ

Mazen Awad, Member, Heat Pipe Technology, Inc, Tampa, FL

2. Upgrading Your Rooftop: Energy Recovery Applications in Commercial Unitary Equipment

Kristin Sullivan, P.E., Member, Ingersoll Rand, La Crosse, WI

Tuesday, January 15

Tuesday, January 15, 8:00 AM - 9:30 AM

Debate 2 (Intermediate)

Filtration Doesn't Matter... or Does it?

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A410

Sponsor: 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment

Chair: Marilyn Listvan, Member, Listvan Consulting, Edina, MN, Jeffrey Siegel, Ph.D., Fellow ASHRAE, University of Toronto, Toronto, ON, Canada, Matt Middlebrooks, Filtration Group, Dallas, TX, Donald Thornburg Jr., Member, Camfil USA, Riverdale, NJ and Dennis Stanke, Member, Retired, West Salem, WI

This debate explores the role and value of air filtration in HVAC systems. Indoor Air Quality is an essential contribution to Occupant Comfort, yet comes at a cost. Both sides of filtration's contribution to IAQ and value will be addressed.

8:00 AM - 9:30 AM

Conference Paper Session 13 (Intermediate)

Efficiency and Health Benefits of Modern Hydronic Systems

Track: Systems and Equipment

Room: Building A, A303

Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

Focus on energy efficiency and public health have been common topics in ASHRAE over the past few years. Several papers on energy efficiency in hydronic systems and one statistical analysis of Legionella in cooling water systems are presented.

1. Legionella Regulation, Cooling Tower Positivity and Water Quality in the Quebec Context: A Review of Field Data (AT-2019-C042)

Patrick Racine, P.Eng., Member¹, Steve Elliott² and Stephen Betts², (1)Klenzoid Canada - a DuBois Company, GUELPH, ON, Canada, (2)Klenzoid Canada, Mississauga, ON, Canada

2. Method for Centrifugal Chiller Power Estimation and Prediction: Development and Verification (AT-2019-C043)

Marcelo Acosta, P.E., Member and Vladimir Suslov, Armstrong Fluid Technology, Toronto, ON, Canada

3. Industry, Government and Academia Partner to Achieve SCOP>5 Hot-Climature MEPS Air-Cooled Chiller (AT-2019-C044)

Peter Armstrong, Ph.D., P.E., Member and Muhammad Tauha Ali, Member, Masdar Institute, Khalifa University of Science and Technology, Abu Dhabi, United Arab Emirates

4. Effect of the Specification of Chilled and Hot Water Coil on Efficiency of Air Conditioning System with Water Thermal Storage (AT-2019-C045)

Tomoya Kawaji, BEAP, Associate Member¹, Hiroshi Ninomiya, Member², Kazuki Nakatsuka, Affiliate³, Nobuo Nakahara, Ph.D., P.E., Affiliate⁴ and Ryuji Yanagihara, Ph.D., Affiliate⁵, (1)Aichi Institute of Technology, Toyota, Japan, (2)Nikken Sekkei, Tokyo, Japan, (3)Sanko Air Conditioning, Osaka, Japan, (4)NESTEC, Osaka, Japan, (5)R.Y. Environment & Energy Design, Osaka, Japan

8:00 AM - 9:30 AM

Seminar 43 (Basic)

Adapting to Thrive: Shaping Resilient Future Urban Performance through Historical Insight

Track: The Engineer's Role in Architecture

Room: Building A, A301

Sponsor: CIBSE ASHRAE Liaison Committee

Chair: Tim Dwyer, CEng, Fellow ASHRAE, University College London, London, United Kingdom

Changes in the external climate and in the expectations of building owners and occupants are a game changer for designers and operators. This seminar shows that success in engineering the future built environment can be powered through knowledge and experience amassed from previous projects, research and operation. It discusses how engineers and their societies, such as ASHRAE and CIBSE, can adapt their historic knowledge base to meet future challenges and deliver solutions to meet the needs of tomorrow's clients and society. The presentations illustrate this by considering technological innovations that are firmly founded on robust historical insight.

1. Adapting to Change

Stephen Lisk, CIBSE President and OneEightLight, Bristol, United Kingdom

2. From Historical Pankhā to Traditional Ceiling Fan: Low-energy Cooling and Ventilation in Indian Homes

Dennis Loveday, Ph.D., Loughborough University, Loughborough, United Kingdom

4. Going Digital: Modeling Historical Infrastructure

Drury Crawley, Ph.D., BEMP, Fellow ASHRAE, Bentley Systems, Inc., Washington, DC

8:00 AM - 9:30 AM

Seminar 44 (Intermediate)

How was that Supposed to Work Again? The Importance of Documented and Understandable Sequences of Operation throughout the Life Cycle of a High Performance Building

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A404

Sponsor: 7.3 Operation and Maintenance Management, 7.9 Building Commissioning

Chair: Mina Agarabi, P.E., Member, Agarabi Engineering PLLC, New York, NY

Facilities personnel come and go. Training to understand the HVAC system in their building is always a challenge. A properly constructed narrative and graphical style Sequences of Operation is potentially the best training tool available as subsequent generations of building personnel are trained. This seminar discusses how a narrative sequence can serve the purposes of both immediate construction and long term operations.

1. Different Writers, Different Readers, Different Styles

James Coogan, P.E., Associate Member, Siemens Building Technologies, Chicago, IL

2. Case Study: Comparing Effective and Ineffective SOO

Bill Gnerre, Member, Interval Data Systems, Waltham, MA

3. The SOO as a Tool for Construction and Operations

Michael Gallagher, P.E., Member, Western Allied Corporation, Santa Fe Springs, CA

8:00 AM - 9:30 AM

Seminar 45 (Intermediate)

HVAC Optimization

Track: HVAC&R Fundamentals and Applications

Room: Building A, A408

Sponsor: Publication and Education Council

Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

There is a strong need to develop new HVAC optimization technologies to increase the energy efficiency and cost effectiveness of HVAC systems in residential and commercial buildings (not only for the customer, but for the manufacturer as well). This seminar presents material from recently published papers from ASHRAE's archival journal, Science and Technology for the Built Environment, on the subject.

1. Development of a Distributed Artificial Fish Swarm Algorithm to Optimize Pumps Working in Parallel Mode

Tianyi Zhao, Ph.D., Dalian University of Technology, Dalian, China

2. Field Test of the ASHRAE/CIBSE/USGBC Performance Measurement Protocols: Parts 1 and 2

Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

3. Multivariable Extremum Seeking Control for a Multi-functional Variable Refrigerant Flow System

Yaoyu Li, Ph.D., Member, University of Texas at Dallas, Dallas, TX

8:00 AM - 9:30 AM
Seminar 46 (Advanced)

Refrigerant Flammability Fundamentals

Track: Refrigeration

Room: Building A, A302

Sponsor: 3.1 Refrigerants and Secondary Coolants

Chair: Stephen Kujak, Member, Trane, Ingersoll Rand, La Crosse, WI

Concerns about the impact of refrigerants on climate change are driving new regulatory policies to restrict and lower the global warming potential (GWP) impact of fluorocarbon refrigerants used in the HVAC&R industry. In response, the industry is developing and examining a new class of lower GWP refrigerants, many of which are flammable. As this transition moves forward, many questions exist about changing to flammable refrigerants options and requirements to use them safely. This seminar highlights research into important considerations unique to flammable refrigerants, that engineers, designers and building owners should keep in mind regarding next-generation refrigerants.

1. Flammability Fundamentals

Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Evaluation of Experimental Methods for Burning Velocity of Flammable Refrigerants

Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD

3. Flammability and Risk Assessment of Low GWP Refrigerants

John Kondziolka, Associate Member, Gradient, Arcadia, CA

4. Hot Surface Ignition Testing of Low GWP 2L Refrigerants

Patrick E. Coughlan, Chemours Fluoroproducts, Wilmington, DE

5. Effects of Temperature and Pressure on Quenching Distances of Low GWP 2L Refrigerants

Kenji Takizawa, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

8:00 AM - 9:30 AM
Seminar 47 (Intermediate)

Securing BACnet Networks: Present and Future

Track: HVAC&R Fundamentals and Applications

Room: Building A, A305

Sponsor: 7.5 Smart Building Systems

Chair: Carol Lomonaco, Member, Johnson Controls, Milwaukee, WI

Securing BACnet networks for confidentiality, integrity and availability (aka CIA Triad) becomes a requirement that should not be neglected. Methods to secure BACnet networks are available today and are outlined in this seminar. BACnet Secure Connect (BACnet/SC) is a new networking option to be added to BACnet which supports IT security for BACnet communications using standard IT technologies used in other critical applications such as online banking. Audit logging and reporting is a complement to securing the communications. Recently added to the standard, it specifies reporting and logging of auditable operations performed by client and server devices on a system.

1. Understanding the Options for Securing your Building Automation Infrastructure

Dave Robin, Automated Logic Inc., Atlanta, GA

2. BACnet Secure Connect (proposed BACnet Addendum 135-2016bj)

Bernhard Isler, Member, Siemens Switzerland Ltd Building Technologies Division, Zug, Switzerland

3. BACnet Audit Reporting and Logging (published BACnet Addendum 135-2016bi)

Michael Osborne, P.Eng., Member, Reliable Controls Corporation, Victoria, BC, Canada

8:00 AM - 9:30 AM
Seminar 48 (Intermediate)

Understanding the Noise and Vibration Associated with Variable Refrigerant Flow (VRF) Systems

Track: Common System Issues and Misapplications

Room: Building A, A405

Sponsor: 2.6 Sound and Vibration

Chair: Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA

Variable Refrigerant Flow (VRF) systems are generally described as high energy efficient and super quiet systems. Though there are some noise and vibration issues that regularly arise that many engineers and contractors are not aware of until there are issues. This session explores some of the most common issues and some best practices to optimize the installation of these systems with respect to noise and vibration.

1. VRF Noise Testing Standards

Jerry Lilly, P.E., Member, JGL Acoustics Inc, Issaquah, WA

2. Vibration Isolation & Noise Control for VRF Condensing Units

Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA

3. A Field Guide to Noise and Vibration Issues for Installed VRF Systems

Roman Wowk, Associate Member, Papadimos Group, San Francisco, CA

Tuesday, January 15, 9:45 AM - 10:45 AM
Conference Paper Session 14 (Intermediate)

Dessicant Dehumidification

Track: Systems and Equipment

Room: Building A, A408

Chair: Christopher R. Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Cambridge, MA

Implementation of dehumidification strategies can improve overall efficiency of cooling systems. This session highlights dessicant dehumidification systems and their impact on energy efficiency. Some of these methods are new methods to increase performance.

1. Desiccant Dehumidification Process for Energy Efficient Air Conditioning (AT-2019-C046)

Jonathan Maisonneuve, Ph.D., Associate Member and Thomas Cremonte, Student Member, Oakland University, Rochester, MI

2. A Novel Heat and Mass Transfer Model for Membrane-based Ionic Liquid Desiccant Air Dehumidifier (AT-2019-C047)

Ming Qu, Ph.D.¹, Joseph Warner, Student Member², Xiaobing Liu, Ph.D., Member³ and Xiaoli Liu, Student Member¹, (1)Purdue University, West Lafayette, IN, (2)Oak Ridge National Lab, Oak Ridge, TN, (3)Oak Ridge National Laboratory, Oak Ridge, TN

3. Sensitivity Study of Crystallization Fouling in a Liquid-to-Air Membrane Energy Exchanger Using Three Desiccant Solutions (AT-2019-C048)

Adesola Olufade, Associate Member and Carey J. Simonson, Ph.D., P.E., Member, University of Saskatchewan, Saskatoon, SK, Canada

9:45 AM - 10:45 AM
Seminar 49 (Intermediate)

Cutting-Edge Japanese Technologies SHASE Annual Award for Smart Community in 2018

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A302

Sponsor: 7.6 Building Energy Performance

Chair: Yasunori Akashi, Ph.D., Member, The University of Tokyo, Tokyo, Japan

The advantages of operating a high-performance system effectively will be introduced in the SHASE Technical Award. One is a set of residential and office blocks in Tokyo, within which power and heat from cogeneration are shared respectively. This Community Energy-Management System helped save 30% of energy and 15% of power. Another is a large university in Nagoya. As well as various technical measures including PV, battery, demand forecast and control of lighting and air-conditioning, this university introduced a "Navigation of Power-Saving System", which controls the R/D facilities.

1. A Smart Community with Energy Sharing for the Existing City Area

Akiko Ushiyama, Shimizu Corporation, Tokyo, Japan

2. Smart Energy Management System for 70 University Buildings

Mitsugu Kawamura, Shimizu Corporation, Tokyo, Japan

9:45 AM - 10:45 AM

Seminar 50 (Basic)

Energy Efficiency and The Impact on Human Health

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A301

Sponsor: EHC, MTG.HWBE Health and Wellness in the Built Environment

Chair: Lan Chi Nguyen Weekes, P.Eng., Member, College La Cite, Ottawa, ON, Canada

As part of the work for the new MTG.MTG.HWBE - Health and Wellness in the Built Environment Multidisciplinary Task Group (MTG), set up to support President Sheila Hayter's agenda for this year, the seminar introduces human-centered building standards, discuss the differences in design, verification and requirements across standards and discusses the research needs for further development of human-centered building standards. As well, the seminar provides an overview of major IAQ problems in buildings, followed by the strategies and technologies for reducing indoor air pollution.

1. Human-Centered Building Standards

Nicholas Clements, Ph.D., Well Living Lab, Rochester, MN

2. Integrated IAQ Strategies via Source Control, Ventilation and Air Purification for Low Energy Buildings

Jensen Zhang, Ph.D., Member, Syracuse University, Syracuse, NY

9:45 AM - 10:45 AM

Seminar 51 (Intermediate)

Ground-Source Heat Pumps Using Carbon Dioxide

Track: Refrigeration

Room: Building A, A404

Sponsor: Publication and Education Council

Chair: Harrison Skye, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

This seminar showcases recent applications and advances in Ground-Source Heat Pumps (GSHPs) using CO₂.

1. Developments in Direct Expansion Ground Source Heat Pumps with CO₂

John Scott, Life Member, Natural Resources Canada, Varennes, QC, Canada

2. Measurements and Energy Analysis for a Prototype Carbon Dioxide Ground Source Heat Pump

Harrison Skye, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

9:45 AM - 10:45 AM

Seminar 52 (Intermediate)

Latest Research Highlights

Track: HVAC&R Fundamentals and Applications

Room: Building A, A405

Sponsor: Publication and Education Council

Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This seminar presents material from recently published papers from ASHRAE's archival journal, Science and Technology for the Built Environment, on the subjects of two ASHRAE research projects on experimental modeling, as well as important new developments on CFD modeling of refrigeration leaks.

1. Experimental Methodology and Results for Heat Gains from Various Office Equipment and Equipment Power Consumption and Load Factor Profiles for Buildings' Energy Simulation (ASHRAE RP-1742)

Omer Sarfraz, Student Member, Oklahoma State University, Stillwater, OK

2. Field Measurement and Modeling of UVC Cooling Coil Irradiation for HVAC Energy Use Reduction (RP-1738): Part 1 and 2

Joseph Firrantello, Ph.D., P.E., Member, Envinity, Inc., State College, PA

3. CFD Modeling of Flammable Refrigerant Leaks inside Machine Rooms- Emergency Ventilation Rate for Different Size Chillers

Paul Papas, Ph.D., United Technologies Research Center, East Hartford, CT

9:45 AM - 10:45 AM

Seminar 53 (Intermediate)

The New Chapter 36 of the HVAC Applications Handbook: Energy and Water Use and Management

Track: HVAC&R Fundamentals and Applications

Room: Building A, A410

Sponsor: 7.6 Building Energy Performance

Chair: Annie Smith, P.E., Associate Member, Ross & Baruzzini, St. Louis, MO

Chapter 36 of the upcoming version of the ASHRAE HVAC Applications Handbook will reflect updates in energy use and management and new sections relating to water use and management. Because of the interconnected nature between energy and water use, sound management of both resources are necessary for the high performance of buildings. This seminar addresses updates and additions to the chapter, including experience, case studies and research that led to the chapter's updated and new content.

1. First Impressions: What is New and Updated about Chapter 36?

John Constantine, Member, Alpha MRC Architects Engineers, Merritt Island, FL

2. Updates on Commercial Building Energy Use and Cost Metrics

Terry Sharp, P.E., Oak Ridge National Laboratory, Oak Ridge, TN

3. Updates on Energy and Water Benchmarking, Conservation and Audits

Eric Yang, P.E., HBDP, CPMP and BEAP, Member, Energy Systems Group, Washington, DC

9:45 AM - 10:45 AM

Workshop 6 (Intermediate)

They Really Did That! Perspectives from State Engineering Board Members

Track: The Engineer's Role in Architecture

Room: Building A, A305

Sponsor: 1.7 Business, Management & General Legal Education

Chair: Michael Bilderbeck, P.E., Fellow ASHRAE, Pickering Firm, Memphis, TN

This workshop deals with the practice of engineering from the perspective of ASHRAE members who are members of the State Engineering Registration Boards. It includes state-to-state differences in rules/laws and requirements that are common among states. It also deals with actual cases that have been adjudicated by the Boards.

1. A Missouri Board Member's Perspective

Kelley Cramm, P.E., Member, Henderson Engineers, Lenexa, KS

2. A Kansas Board Member's Perspective

Richard Hayter, Ph.D., P.E., Presidential Fellow Life Member, Kansas State University Retired, Manhattan, KS

Tuesday, January 15, 11:00 AM - 12:30 PM

Technical Paper Session 3 (Intermediate)

Optimizing Components in HVAC Systems

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A303

Chair: Alamelu Brooks, Member, ICF International, Columbia, MD

Whether looking for new materials for modern refrigerants or optimizing design through CFD, system components play a large role in building performance. This session includes papers on materials and system components for today's high performing building systems.

1. Energy Performance, Comfort and Lessons Learned from a Net-Zero Energy Library (AT-2019-007)

Vasken Dermardiros, P.Eng., Student Member, Concordia University, Montreal, QC, Canada

2. Optimizing Stairway Pressurization Systems By Automating CFD Simulation (WITHDRAWN)

Ali Hasan, Amanties, Doha, Qatar

3. Preliminary Investigations of the Impact of VFD Output Voltage on Motor Efficiency (AT-2019-008)

Gang Wang, P.E., Member, University of Miami, Coral Gables, FL

11:00 AM - 12:30 PM
Seminar 54 (Intermediate)

Chemistry of New and Retrofit Systems with Low GWP Refrigerants

Track: Refrigeration

Room: Building A, A410

Sponsor: 3.2 Refrigerant System Chemistry, MTG.LowGWP Lower Global Warming Potential Alternative Refrigerants

Chair: Edward Hessell, Ph.D., Member, Lanxess Solutions US, Inc., Naugatuck, CT

New low global warming potential refrigerants such as hydrofluoro-olefins (HFOs) are inherently less chemically stable than their predecessors such as hydrofluorocarbons and hydrochlorofluorocarbons. It is imperative that their stability in the presence of lubricants, materials of construction and trace contaminants, such as processing chemicals, water and air, be understood to ensure safe and reliable long term operation of HVACR equipment. This seminar will provide an overview of the various tests and studies being conducted to understand the system chemistry of HVACR systems using HFO refrigerants as viewed from the perspective of HVACR system manufacturers, lubricant suppliers, and refrigerant suppliers.

1. System Chemistry Comparison of HFC and Low GWP Alternatives

Julie Majurin, Member, CPI Fluid Engineering, Midland, MI

2. Evaluation of the Chemical Stability of HFC and HFO Alternatives When Applied as R22 Retrofit in Refrigeration Equipment

Hitomi Arimoto, Associate Member, Daikin Industries, Ltd., Settsu, Japan

3. Chemical Stability of New Low GWP Olefin Based Refrigerants

Stephen Kujak, Member, Trane, Ingersoll Rand, La Crosse, WI

4. What do We Need to Understand About System Chemistry and Low GWP Refrigerants?

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

11:00 AM - 12:30 PM
Seminar 55 (Basic)

Equipment Selections with Respect to Noise and Vibration

Track: The Engineer's Role in Architecture

Room: Building A, A301

Sponsor: 2.6 Sound and Vibration

Chair: Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA

This seminar provides three perspectives on how ventilation equipment is selected with noise and vibration performance in mind. These conversations happen behind the scenes on many projects, now hear it straight from each vested party: acoustic engineers, mechanical engineers, and manufacturers. Each group has different needs, and understand those at the onset can streamline the design, selection, and construction process.

1. Equipment Selections with Respect to Noise and Vibration: Acoustical Consultant's Perspective

Roman Wowk, Associate Member, Papadimos Group, San Francisco, CA

2. Equipment Selections with Respect to Noise and Vibration: Mechanical Engineer's Perspective

Jeff Boldt, P.E., HBDP, Fellow ASHRAE, KJWW Engineering Consultants, Madison, WI

3. Equipment Selections with Respect to Noise and Vibration: Manufacturer's Perspective

Curt Eichelberger, P.E., Member, Johnson Controls, Inc., York, PA

11:00 AM - 12:30 PM
Seminar 56 (Intermediate)

Humidity IS Health

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A305

Sponsor: 5.11 Humidifying Equipment

Chair: Raul Simonetti, Member, Carel Industries SpA, Brugine, Italy

New studies correlate moderate indoor humidity levels with reduced viral and bacterial infections in both young and elderly building occupants. Other health benefits are also seen with these humidity levels. This seminar presents these results, as well as updates on the high-pressure fogging systems recently allowed in healthcare facilities by BSR/ASHRAE/ASHE Addendum m to ANSI/ASHRAE/ASHE Standard 170-2013. In addition, the expected break-even points of some of the currently available humidification solutions will be shown.

1. The Effects of Indoor-Air Relative Humidity on Health Outcomes and Cognitive Function in Residents in a Long-term Care Facility

Stephanie Taylor, M.D., Member, Partners Hospitals, Infection Control Consultant, Boston, MA

2. The Impact of Steam Humidification on Influenza Virus in Preschool Classrooms

Alex Generous, Mayo Clinic Graduate School of Biomedical Sciences, Rochester, MN

3. New Options! Fogging Systems in Healthcare Applications

William Truong, Member, Condair (Nortec) Inc., Ottawa, ON, Canada

4. Estimating the Break-even Point of the Most Common Steam and Adiabatic Systems

Raul Simonetti, Member, Carel Industries SpA, Brugine, Italy

11:00 AM - 12:30 PM

Seminar 57 (Basic)

Multiscale Building Energy Modeling, Part 9

Track: HVAC&R Fundamentals and Applications

Room: Building A, A408

Sponsor: 4.7 Energy Calculations

Chair: Joshua New, Member, Oak Ridge National Laboratory, Knoxville, TN

Development of urban or multiscale building energy models is becoming increasingly tractable for many applications including city-wide energy supply/demand strategies, urban development planning, electrical grid stability and urban resilience. This seminar has assembled researchers and practitioners from universities or industry within the United Kingdom, Canada and the United States with capabilities in the field of multiscale energy models to discuss the data, algorithms, workflow and practical challenges addressed in their applications involving building energy analysis at the scale of a city.

1. Modelling London's Building Stock and its Associated Energy Use

Paul Ruyssevelt, Ph.D., University College London, London, United Kingdom

2. Using Regional Building Modeling for Energy Forecasting

David Shipley, P.Eng., Member, ICF Marbek, Ottawa, ON, Canada

3. Wide-area 3D Imaging Using Foliage-penetrating Laser Radars for City-scale Building Evaluation

Eric Statz, Ph.D., MIT Lincoln Laboratory, Boston, MA

4. Building Modeling and District System Optimization at Scale

Peter Ellis, Member, Big Ladder Software, Denver, CO

11:00 AM - 12:30 PM

Seminar 58 (Intermediate)

Not your Father's Onsite Energy Generation System: Lessons Learned from 135 Years Applying Combined Heat and Power Systems (CHP)

Track: Common System Issues and Misapplications

Room: Building A, A302

Sponsor: 1.10 Cogeneration Systems

Chair: Richard Sweetser, Life Member, Exergy Partners Corp., Herndon, VA

Building integrated CHP systems are increasingly being applied to save money, increase event resilience, improve power quality, support microgrids, and/or reduce carbon emissions. Nevertheless, many in the building engineering community have little or no knowledge about or experience with CHP system design or application. Each region throughout the USA has unique engineering, climate and policy approaches to energy. This seminar reviews important CHP lessons learned from real 21st century installations in three East Coast regions.

1. Lessons Learned from 98 CHP Systems Operating in New York State Since 2000

Hugh Henderson, CDH Energy Corp., Cazenovia, NY

2. CHP Design and Application Lessons Learned from the Mid-Atlantic Region Since 2000

Gearoid Foley, Member, Integrated CHP Systems Corp, Princeton, NJ

3. CHP Design and Application Lessons Learned from the Southeast Region Since 2000

Bruce Hedman, Dr.Ing., Entropy Research, LLC, Alexandria, VA

11:00 AM - 12:30 PM
Seminar 59 (Intermediate)

Transient Temperature Changes in the Data Center: Should We Be Worried?

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A404

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

Chair: Joseph Gangemi, Life Member, Northern Air Systems, Rochester, NY

The thermal environment of most mission-critical spaces is designed and operated to respect steady-state temperature limits. However, a robust and resilient facility must endure cooling-equipment failure and even periods with a complete loss of utility power. Even under "normal" conditions, IT loads vary and cooling units cycle on and off. Predictive modeling can improve transient performance by influencing design choices and allowing operators to optimize the control of systems they already have. Predictive modeling further reveals that it is difficult to comply with current ASHRAE Thermal Guidelines. This provocative seminar explores these issues and suggests a path forward.

1. Data Center Temperature Rise following the Loss of Primary Power

James W. VanGilder, P.E., Member, Schneider Electric, Andover, MA

2. The Impact of Airside and Waterside Failure on Data Center Lab Cooling Performance

Kourosh Nemati, Ph.D., Future Facilities Incorporated, New York, NY

3. Modeling Transient Behavior in a Data Center: When is it Needed?

Mark Seymour, CEng, Member, Future Facilities Ltd, London, United Kingdom

Tuesday, January 15, 1:00 PM - 1:30 PM
Seminar TC (Basic)

Want to CONTROL the World?

Track: HVAC&R Fundamentals and Applications

Sponsor: 1.4 Control Theory and Application

Chair: Elise Backstrom, Associate Member, M+W Group, Phoenix, AZ

Many millennial engineers view controls as a mysterious black box, however advanced building integrated controls are a key feature in moving toward a net zero energy future. How will we move toward this future if our engineers don't know how to design it? TC 1.4 has implemented a social media approach to educate and familiarize all engineers with controls theory and application using one of the most popular platforms among young engineers. Through the use of fielded questions and answers by experts within the HVAC&R industry, controlling the world will prove to not be as intimidating as young engineers think.

1. Want to Control the World?

Michelle Shadpour, Student Member, SC Engineers, Inc., San Diego, CA

1:00 PM - 3:00 PM

Seminar

ASHRAE-UNEP-UNIDO Seminar on Advancing Lower-GWP Alternatives in Air-Conditioning Sector in the Middle East

Room: Building B, B305

Open session – no badge required.

With the advancement of the Montreal Protocol over the last three decades which recently, in 2016, concluded with a major milestone to control and phase-down HFCs under what is known now as the **Kigali Amendment**; the air-conditioning sector passed also through several shifts in terms of type of refrigerants to be considered as ozone friendly and with lower-GWP impact. The **High Ambient Temperature (HAT)** countries have its unique characteristics when it comes to the cooling needs due to the harsher climatic conditions which is connected to suitability of alternative refrigerants that can work in HAT conditions while still meet energy efficiency requirements which became critical for many countries, in particular in the Middle East region, due to the higher % of air-conditioning sector contribution to power demand i.e. almost 50% + in most of those countries.

UN Environment and **UNIDO** has been working, together, over years in assisting HAT countries in the phase-out of ozone depleting substances (ODSs) including projects for the air-conditioning sectors. Over the last five years and with support from the Multilateral Fund (MLF) of Montreal Protocol, both UN agencies designed and implemented several demo projects to explore and showcase opportunities of deploying lower-GWP technologies in different air-conditioning sectors with emphasis on feasibility for HAT countries. Starting with UN Environment-UNIDO High Ambient project, so-called “**PRAHA**”, Egypt designed a similar program, for the air-conditioning industry aiming at building and testing prototypes of different commercial/residential air conditioners with lower -GWP refrigerants which is known as “**EGYPRA**”. AHRI also contributes to the efforts to examine suitable alternative refrigerants for HAT operating conditions. The AHRI Low-GWP Alternative Refrigerants Evaluation Programme so called “**AREP**” included testing of lower-GWP alternative refrigerants in HAT conditions. AHRI is also contributing to the testing and optimization program of PRAHA-II project in cooperation with UNEP and UNIDO.

Away from conventional technologies, MLF also awarded UN Environment and UNIDO two demo projects to conduct feasibility studies about using **Not-in-Kind** technologies in District Cooling and Central air-conditioning applications. The two studies were conducted in Egypt and Kuwait examining different types of technologies i.e. Deep-Sea Cooling, Natural Gas Absorption Chillers and Two-Stages Direct/Indirect (TSDI) Evaporative Cooling.

Within the same context. **ASHRAE** has been cooperating with UN Environment for the last ten years in advancing knowledge and technologies about sustainable technologies and practices in developing countries especially in relation to management of refrigerants and promotion of lower-GWP options. ASHRAE also is cooperating with District Cooling industry in the Middle East to advance practices and sustainable operation of District Cooling plants. A new guide is under development by ASHRAE in this regard which will offer important reference to industry especially in HAT countries where this sector is witnessing rapid growth. This Seminar intend to shed light on above mentioned efforts and to educate audience about potentialities for using lower-GWP technologies in HAT operating conditions.

Tuesday, January 15, 1:30 PM - 3:00 PM

Seminar 60 (Intermediate)

Lighting up Indoor Environmental Quality Interactions in Schools: Impact on Health and Performance

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building A, A410

Sponsor: SGPC 10

Chair: Walter Grondzik, P.E., Fellow ASHRAE, Ball State University, Muncie, IN

This seminar sheds light on how student health and performance are impacted by indoor environmental quality in schools, spanning thermal, indoor air quality, lighting and acoustic conditions and their interactions. The United States EPA sponsored seven projects under the Science to Achieve Results (STAR) program, focused on "Healthy Schools: Environmental Factors, Children's Health and Performance, and Sustainable Building Practices". Three project investigators present their findings. This seminar benefits those working in the design, construction and operation of K-12 educational buildings by providing a better understanding of how indoor environmental quality can benefit occupants in educational settings.

1. An Investigation of Indoor Environmental Factors and Their Effects on K-12 Student Achievement

Lily Wang, Ph.D., P.E., University of Nebraska - Lincoln, Lincoln, NE

2. Identifying the Determinants of Indoor Air Quality in Schools in mid-Atlantic Region and Their Impacts on Student Performance

Kirsten Koehler, Ph.D., Johns Hopkins University, Baltimore, MD

3. Did School Indoor Environment Affect Health and Performance among the Students and Teachers in New York State?

Tia Marks, University at Albany-SUNY, Albany, NY

4. Indoor Air Quality in High Schools in Central Texas

Atila Novoselac, Ph.D., Member, University of

Tuesday, January 15, 3:15 PM - 4:45 PM

Debate 3 (Intermediate)

College of Fellows Debate: Owners Owe a "Standard of Care" to their Projects

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building A, A410

Sponsor: 1.7 Business, Management & General Legal Education, College of Fellows

Chair: Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA, Don Beaty, P.E., Fellow ASHRAE, DLB Associates, Eatontown, NJ, Stephen Lisk, CIBSE President and OneEightLight, Bristol, United Kingdom, Martin Weiland, P.E., Member, US General Services Administration, Washington, DC, Robyn Ellis, Associate Member, City of Hamilton - Public Works, Hamilton, ON, Canada, E. Mitchell Swann, P.E., Member, MDCSystems, Paoli, PA and Michael Cooper, P.E., Member, Bernhard Mechanical Contractors, Metairie, LA

Barreling through the industry is the quest for quantifiable measurement of building performance. Most times it's "high", but frankly you'll need to measure "medium" and "low" to know what "high" performance is. The industry has long bemoaned the quality of O&M. O&M is an "over time" activity and performance can only be measured "over time". Designers are obliged to meet the Standard of Care; contractors, the "custom and practice". But what about owners? Do owners have comparable obligations to a project? Do Owners have a Standard of Care? What have ye? Yay or Nay? Come listen, consider, and weigh in.

Wednesday, January 16

Wednesday, January 16, 8:00 AM - 9:30 AM

Conference Paper Session 15 (Intermediate)

Advances in Heat Recovery

Track: Systems and Equipment

Room: Building B, B408

Chair: Zheng O'Neill, University of Alabama, Tuscaloosa, AL

Heat recovery and energy efficiency of boiler systems go hand in hand. Increasing boiler and heat recovery efficiency reduces carbon emissions and drives our industry towards our new energy future. Come hear presentations on what is new in boiler and heat recovery efficiency.

1. A Liquid-Desiccant-Based Heat Recovery System for Gas-fired Boilers in District Heating Networks (AT-2019-C049)

Xiaoyue Zhang, Student Member and Zhen Li, Dr.Eng., Member, Key Laboratory of Thermal Science and Power Engineering of Ministry of Education, Tsinghua University, Beijing, China

2. Integrated Heat Recovery System Design of a Variable Refrigerant Flow (VRF) Heat Recovery System with a Domestic Hot Water System (AT-2019-C050)

Dongsu Kim, Student Member¹, Heejin Cho, Ph.D., Associate Member¹, HyunJin Nam² and Jaeyoon Koh, Ph.D., Member³, (1)Mississippi State University, Mississippi State, MS, (2)LG Electronics, Seoul, Korea, Republic of (South), (3)LG Electronics U.S.A., Inc., Alpharetta, GA

3. A Case Study of Sensitivity Analysis of the Domestic Hot Water System in Large Hotels (AT-2019-C051)

Zhihong Pang and Zheng O'Neill, Ph.D., P.E., Member, The University of Alabama, Tuscaloosa, AL

4. Demonstrating the Benefit of Multi-Objective Optimization and Clustering for the Design of Waste Heat Recovery Systems (AT-2019-C052)

Gabriel Legorburu, Associate Member and Amanda Smith, Associate Member, Utah University, Salt Lake City, UT

8:00 AM - 9:30 AM

Conference Paper Session 16 (Intermediate)

Building Performance with Respect to Energy Efficiency

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B409

Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

Energy efficiency is a key performance indicator of building performance. After design, implementation and commissioning, performance must be maintained to realize the impact of energy efficient technologies. This session illustrates methods to determine building performance and KPI's for operating at design efficiencies.

1. Energy, Emissions and Economics (EEE) Impact Derivation and Applications for Energy Performance Calculations and Comparisons (AT-2019-C053)

Neil Leslie, P.E., Member¹ and David Goldstein², (1)Gas Technology Institute, Des Plaines, IL, (2)Natural Resources Defense Council, San Francisco, CA

2. System-level Key Performance Indicators (KPIs) for Building Performance Evaluation (AT-2019-C054)

Han Li, Associate Member¹, Marina Sofos² and Tianzhen Hong, Ph.D., Member¹, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)U.S. Department of Energy, Washington, DC

3. Taking the (Fuel) Blinders off Energy Codes Part 2: Metrics and Mechanics in the Modern Era (AT-2019-C055)

Alexi Miller, P.E., Associate Member and Jim Edelson, Associate Member, New Buildings Institute, Portland, OR

4. Targeting Building Energy Efficiency Opportunities: An Open-source Analytical and Benchmarking Tool (AT-2019-C056)

Han Li, Associate Member¹, Ahmed Bekhit², Carolyn Szum¹, Clay Nesler, Member³, Sara Lisuaskas² and Steven Snyder, P.E., Member⁴, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)ICF International, Toronto, ON, Canada, (3)Johnson Controls, Milwaukee, WI, (4)Johnson Controls, Philadelphia, PA

8:00 AM - 9:30 AM

Seminar 61 (Intermediate)

Building Data Exchange Formats: Sharing Building Data with Ease

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B313b

Sponsor: 7.6 Building Energy Performance

Chair: Jim Kelsey, P.E., Member, kW Engineering, Oakland, CA

Collecting and exchanging building data is become more and more necessary since the digitization of the design and operation of buildings. In addition, several jurisdictions are now requiring mandatory benchmarking, energy auditing, and specific ratings (bEQ, LEED, Energy Star, etc.) to be performed on buildings. These jurisdictions are forcing the exchange of a large amount of detailed building data such as building characteristics (e.g. building geometry, areas, building types, HVAC system definition) as well as building performance data. This seminar discusses existing formats used for building energy data exchange such as gbXML, HPXML, and BuildingSync.

1. Green Building XML (gbXML) and Its Role in BIM and Analysis Software Interoperability

Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

2. Exchanging Home Performance Data with HPXML

Noel Merket, National Renewable Energy Laboratory, Golden, CO

3. BuildingSync: Data Exchange from Commercial Building Energy Audits

Nicholas Long, Member, National Renewable Energy Laboratory, Golden, CO

8:00 AM - 9:30 AM

Seminar 62 (Intermediate)

Room Air Cleaner, Can it Improve IAQ?

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B201

Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Kyung Choi, Member, Clean and Science, Louisville, KY

As a solution to Indoor Air Quality (IAQ) issues, room air cleaners are widely used in indoor environments. These room air cleaners use a combination of different air cleaning technologies to remove wide ranges of pollutants such as particulate matters, bioaerosols, volatile organic compounds and inorganic gases. Some room air cleaners use ionizers which may produce ozone. It is important to understand how IAQ monitoring devices work.

- 1. Ozone Reaction with Human Surfaces Due to Ozone-emitting Air Cleaners**
Youngbo Won, Student Member, Penn State University, University Park, PA
- 2. Modern IAQ Monitoring MOS Devices Especially for Residential Environment**
Tomohiro Kawaguchi, Figaro Engineering Inc, Osaka, Japan
- 3. Performances of Electric Air Cleaning Technologies for Gas/Vapor Removal**
Chang-Seo Lee, Ph.D., Associate Member, Concordia University, Montreal, QC, Canada
- 4. Impact of Portable Air Cleaners on Residential IAQ: Testing and Simulation**
Thad Ptak, Ph.D., Member, A. O. Smith Corporation, Milwaukee, WI

8:00 AM - 9:30 AM

Seminar 63 (Basic)

The Force is Strong with this One: Facilitating Integrated Project Delivery

Track: The Engineer's Role in Architecture

Room: Building B, B315

Sponsor: 7.1 Integrated Building Design

Chair: Marianna Vallejo, Ph.D., Jacobs, Portland, OR

Integrated design and delivery require a collaborative effort from all parties throughout project life cycle. This requires a shift in how we as an industry think about and deliver projects. Baby steps are allowed. This seminar discusses various aspects of integrated project delivery and strategies to implement an integrated design process. This session will consider ways to successfully facilitate integrated project delivery, from current perceptions around integrated design to tools, processes, and the roles we might play.

1. Jedi Mind Tricks for Integrated Project Delivery (But First you Must Believe...)

Mitchell Swann, P.E., MDC Systems, Paoli, PA

2. The Force is Strong with This One: Integrated Design Process Perceptions

Michel Tardif, CanmetENERGY, Ottawa, ON, Canada

3. The Force will be with You, Always: Facilitating Success in Integrated Project Delivery

Lianne Cockerton, P.Eng., Martin Roy et Associés, Montreal, QC, Canada

4. Welcome to the Dark Side: Simulation in the Integrated Design Process

Danielle Monfret, Ph.D., École de technologie supérieure, Montreal, QC, Canada

8:00 AM - 9:30 AM

Seminar 64 (Intermediate)

Thermodynamic Limits for Buildings: Part 2

Track: HVAC&R Fundamentals and Applications

Room: Building B, B309

Sponsor: 7.4 Exergy Analysis for Sustainable Buildings (EXER)

Chair: Ongun Kazanci, Ph.D., Associate Member, International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

This seminar addresses the issues mechanical system design engineers encounter in daily situations, but cannot appropriately address with energy analysis only. Since exergy analysis enables the comparison of different forms of energy and different energy qualities, it makes it possible to optimize the performance of an HVAC system holistically, including fan and pump powers. This session includes presentations from practitioners and from researchers, and will cover the applicability of exergy analysis in optimizing the HVAC system performance, and how we can use exergy analysis to reach net zero energy or exergy building targets.

1. Thermodynamic Limits for Buildings: Energy vs Exergy

Atilla Biyikoglu, Ph.D., Member, Gazi University, Ankara, Turkey

2. When Do the Results of Exergy Analysis Differ from Energy Analysis?

Antash Najib, Student Member, University of California, Davis, CA

3. Exergy Losses in a Hydronic System and How to Avoid Them

Mike Trantham, Member, IMI Flow Design, Dallas, TX

4. Is Work-to-Heat Ratio (WTHR) a Better Metric Than COP for Exergy Analysis?

William Kopko, Member, Johnson Controls, New Freedom, PA

8:00 AM - 9:30 AM

Seminar 65 (Intermediate)

The Role of Energy Storage for Buildings Integrated with Renewable Energy Systems

Track: Renewables and Natural Systems

Room: Building B, B313a

Sponsor: 6.9 Thermal Storage

Chair: Paulo Tabares, Colorado School of Mines, Golden, CO

Design of sustainable buildings and net-zero buildings requires careful integration between onsite renewable energy systems, energy storage, and the built environment. This session shows case recent advances in modeling tools and field and numerical studies that consider natural systems, energy storage, efficiency measures and onsite renewable energy systems at the building and campus scale in different locations across the U.S.

1. The Necessity of Thermal Energy Storage as Part of Net-Zero Building Design

Karl Heine, Student Member, Colorado School of Mines, Golden, CO

2. Sizing and Dispatch Strategy of a Renewable System for a Cluster of Buildings in a Campus Scale

Mohammad Hassan Fathollahzadeh, Student Member, Colorado School of Mines, Golden, CO

3. Thermal Energy Storage for a Movie Theater with Integrated PV Systems: A Case Study

Marcel Christians, Ph.D., Ice Energy, Santa Barbara, CA

8:00 AM - 9:30 AM

Workshop 7 (Intermediate)

An Overview of the Newly Published Guideline 36

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B407

Sponsor: 1.4 Control Theory and Application

Chair: Mark Hydeman, P.E., Fellow ASHRAE, Google, Mountain View, CA

This workshop is intended to familiarize attendees with the newly published Guideline 36 The Next Generation Control System and the TC 1.4 Control Research agenda that will provide future content.

Wednesday, January 16, 9:45 AM - 10:45 AM

Panel 1 (Basic)

The Cage Match: An Uncommon Approach to Accelerating ASHRAE Standard Development

Track: HVAC&R Fundamentals and Applications

Room: Building B, B408

Sponsor: 5.4 Industrial Process Air Cleaning (Air Pollution Control)

Chair: Chris Lowell, Member, Halton Company, Scottsville, KY

This panel draws upon the panelists unique experiences in moving forward ASHRAE Standard development. Facing stagnation or lack of progress can be daunting when developing an ASHRAE Standard. Even more so, it sometimes appears there is no end and the Standard stays in development for perpetuity. The panelists share their experiences in pushing through these boundaries to cross the finish line with an ASHRAE Standard.

1. The Cage Match: An Uncommon Approach to Accelerating ASHRAE Standard Development

Bob Burkhead, Member¹, Chris Fischer², Bruce McDonald, P.Eng., Member³ and Geoff Crosby⁴, (1)Blue Heaven Technology, Louisville, KY, (2)University of Kentucky, Lexington, KY, (3)Consultant, Minneapolis, MN, (4)Lydall, Rochester, NH

9:45 AM - 10:45 AM

Conference Paper Session 17 (Intermediate)

Numerical Techniques for HVAC Design

Track: HVAC&R Fundamentals and Applications

Room: Building B, B409

Chair: Ratmesh Tiwari, Ph.D., Member, University of Maryland, College Park, MD

Numerical modeling methods aid the design engineer from conception to component selection. New techniques for demonstrating these concepts are illustrated with metrics that the design professional can implement.

1. Comparison of Approaches for Calculating Annualized Data Center Energy Metrics(AT-2019-C057)

Rehan Khalid, Student Member and Aaron Wemhoff, Villanova University, Villanova, PA

2. Study on the Prediction Models of Temperature and Energy by using DCIM and Machine Learning to Support Optimal Management of Data Center (AT-2019-C058)

Kosuke Sasakura, Takeshi Aoki and Takeshi Watanabe, NTT Facilities, Inc., Tokyo, Japan

3. Cooling System with Low Power Usage Effectiveness Below 1.02x for Server Rooms (AT-2019-C059)

Naoki Aizawa, BEAP, Takasago Thermal Engineering Co.,Ltd., Kanagawa, Japan

9:45 AM - 10:45 AM

Conference Paper Session 18 (Intermediate)

Thermal Comfort in Transportation

Track: HVAC&R Fundamentals and Applications

Room: Building B, B313b

Chair: Christopher R. Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Cambridge, MA

Thermal comfort in transportation has different considerations than in large buildings. Many of the systems have different designs and components. This session discusses strategies for thermal comfort on air land and sea.

1. Novel Ventilation Concepts for Efficient Heating Dynamics of Vehicle Passenger Compartments (AT-2019-C060)

Tobias Dehne, CPMP, Andreas Westhoff and Pascal Lange, German Aerospace Center (DLR) Institute of Aerodynamic and Flow Technology, Göttingen, Germany

2. Numerical Investigation of Thermal Comfort Inside Cruise Ships (AT-2019-C061)

Essam E. Khalil, Ph.D., P.E., Fellow ASHRAE, Ahmed Emad, P.E., Gamal ElHarriry, Ph.D., P.E. and Taher Abou Dief, Ph.D., P.E., Member, Cairo University, Cairo, Egypt

3. Shape Effectiveness of HVAC Outlets on Automobile Thermal Comfort (AT-2019-C062)

Essam E. Khalil, Ph.D., P.E., Fellow ASHRAE, Ahmed ElDegwy, Ibrahim Reda and Taher Abou Dief, Ph.D., P.E., Member, Cairo University, Cairo, Egypt

9:45 AM - 10:45 AM

Seminar 66 (Basic)

How ASHRAE Standard 100 can be Applied to Atlanta's Building Energy and Water Efficiency Ordinance

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B407

Sponsor: 2.8 Building Environmental Impacts and Sustainability, SSPC 100

Chair: Kevin Brown, P.E., Member, ABM Technical Solutions, Atlanta, GA

Learn how cities with energy conservation goals can adopt Standard 100 to boost energy efficiency in existing buildings. Hear from the City of Atlanta and get an update on how their program is progressing. Additionally, this seminar discusses background information on ASHRAE Standard 100 and goes through the steps of the Standard 100 compliance flow chart.

1. How to Use ASHRAE Standard 100 and Seek Compliance

Curtis Fong, Associate Member, Taylor Engineering, Alameda, CA

2. Atlanta's Building Energy and Water Efficiency Ordinance

Megan O'Neil, City of Atlanta, Atlanta, GA

9:45 AM - 10:45 AM

Seminar 67 (Intermediate)

In Legionella, Measure What Matters: Insights for the Water Quality Practitioner

Track: Common System Issues and Misapplications

Room: Building B, B315

Sponsor: 9.6 Healthcare Facilities

Chair: Lan Chi Nguyen Weekes, P.Eng., Member, College La Cite, Ottawa, ON, Canada

Water Management Plans are considered a good tool to manage bacterial growth including Legionella in Building Water Systems. However, water management plans that are being developed are missing important information. This seminar will discuss the state of science and the latest key insights from standards and guidelines that the practitioner needs to know. Case studies will be used to show what a good management plan consists of and what is missing from others

1. Legionella: State of Science and Regulations

Lan Chi Nguyen Weekes, P.Eng., Member, College La Cite, Ottawa, ON, Canada

2. Why Do I Have to Manage Water? Legionella That's Why?

Nate Sanders, Liberty Building Forensics Group, Zellwood, FL

9:45 AM - 10:45 AM
Seminar 68 (Advanced)

Integration of Renewable Systems and Natural Ventilation: Control Challenges

Track: Renewables and Natural Systems

Room: Building B, B309

Sponsor: 1.4 Control Theory and Application

Chair: Michelle Shadpour, Student Member, SC Engineers, Inc., San Diego, CA

Smart engineers are designing even smarter buildings but what are the challenges to getting there? The application of smart systems has resulted in a duplication of effort and, at times, results in conflicting controls parameters. This seminar identifies proper application, monitoring and integration of sustainable systems into the building automated controls and examines resulting issues that may arise. This seminar tackle these issues because a building can only perform as great as the control system allows it!

1. What to do with all this Energy? The Trick to Tracking and Controlling Green Systems.

Larry Scholl Jr., Member, Automated Logic, Kennesaw, GA

2. Renewable Systems Integration; A Key to Smart Buildings Success

Michael Pouchak, P.E., Member, Honeywell International, Golden Valley, MN

9:45 AM - 10:45 AM
Forum 2 (Intermediate)

Empirical Verification of Metabolic Heat, Moisture and Contaminant Dissipation Rates from Occupants at Various Activity Levels

Track: HVAC&R Fundamentals and Applications

Room: Building B, B201

Sponsor: 2.1 Physiology and Human Environment

Chair: Hui Zhang, Ph.D., University of California at Berkeley, Berkeley, CA

ASHRAE publications currently reference values of metabolic sensible and latent heat, moisture and contaminant dissipation rates that are based on research conducted by ASHRAE and others over 40 years ago. This forum addresses potential future studies with modern calorimetric methods to ascertain values that reflect current occupant activities and demographics.

9:45 AM - 10:45 AM
Forum 3 (Advanced)

Environmental Health Trends Impacting HVAC&R

Track: HVAC&R Fundamentals and Applications

Room: Building B, B313a

Sponsor: 7.6 Building Energy Performance

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

ASHRAE Environmental Health Committee (EHC) is responsible for identifying major environmental health trends impacting the practice of HVAC&R. This forum seeks feedback from attendees related to the current environmental health trends in the industry. How these trends are impacting our industry? How ECH can be proactive in response to these trends? How ECH can reach out to other organizations to develop avenues for information exchange and collaboration? This session will brainstorm these questions and will attempt to identify current trends in environmental health. Active participation is required from the attendees.

Wednesday, January 16, 11:00 AM - 12:30 PM

Debate 4 (Intermediate)

Intelligent, Efficient and Resilient Data Centers: What is Needed? Rules of Thumb, Science or Just Technology?

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B201

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

Chair: Bahgat Sammakia, Ph.D.¹, Roger Schmidt, Ph.D., P.E., Member², Kanad Ghose, Ph.D.¹, Dereje Agonafer, Ph.D., Member³ and Mark Seymour, CEng, Member⁴, (1)Binghamton University, Binghamton, NY(2)IBM, Poughkeepsie, NY(3)University of Texas at Arlington, Arlington, TX(4)Future Facilities Ltd, London, United Kingdom

Designing, operating and maintaining a modern data center presents a host of options - but what is important and how should you choose? Is it sufficient just to produce a design that operates within guidelines? Do you need a scientific assessment? Or, will pure technology win the day? Leading individuals from the National Science Foundation Center for Energy-Smart Electronic Systems will debate what's important, including ASHRAE thermal guidelines, power and cooling infrastructure, IT cooling systems and intelligent controls. Come and join this controversial debate on how to have a best in class data center today and tomorrow.

11:00 AM - 12:30 PM

Technical Paper Session 4 (Intermediate)

Analysis of Building Systems

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B408

Chair: Bass Abushakra, Ph.D., Member, United States Military Academy, West Point, NY

Research on analyzing and methods of analyzing building systems is important to society as a whole. When writing standards, this information is relied on for modeling purposes, basing decisions and ensuring we are leading the industry in our standards. This session presents research on evaluating various systems and provides valuable information performance.

1. Energy Performance of an Occupancy-Based Climate Control Technology in Guest Rooms (AT-2019-009)

Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

2. Evaluating the Capability of Algebraic Equations in Accurately Determining the First Sighting of a Smoke Layer in a Steady State Fire Condition in Atriums: A CFD Approach (WITHDRAWN)

Ali Hasan, Amanties, Doha, Qatar

3. HVAC System Air Leakage Requirements for Deep Energy Retrofit Projects (AT-2019-010)

Alexander Zhivov, Ph.D.¹, Herman Behls, P.E., Member², Craig Wray, P.Eng., Member³, Larry Smith, P.E.⁴ and Lars-Åke Mattsson⁵, (1)US Army Engineer Research and Development Center, Champaign, IL, (2)Deceased, Formerly, Arlington Heights, IL, (3)Mechanical Engineer, Winnipeg, MB, Canada, (4)Linx Industries, Portsmouth, VA, (5)Lindab Ventilation AB, Båstad, Sweden

4. Representative Layer-by-Layer Descriptions for Fenestration Systems with Specified Bulk Properties Such as U-factor and SHGC (1588-RP) (AT-2019-011)

Yu Joe Huang, Member, White Box Technologies, Inc., Moraga, CA

5. Development of a Reference Building Information Model (BIM) for Thermal Model Compliance Testing (RP-1468) Part-II: Test Cases and Analysis (AT-2019-012)

Jeff Haberl, Ph.D., BEMP, Fellow ASHRAE, Texas A & M University, College Station, TX

11:00 AM - 12:30 PM

Conference Paper Session 19 (Intermediate)

Advances in Refrigerants

Track: HVAC&R Fundamentals and Applications

Room: Building B, B409

Chair: Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

New refrigerants and advancements in refrigerants is a key topic in ASHRAE. Through ASHRAE research and other industry organizations, refrigerants are more relevant than ever. This session provides several papers on modern refrigerants and their application.

1. Flammable Refrigerants: Performance Comparison, Safeties and Lessons Learned (AT-2019-C063)

Sean O'Hern, Associate Member, Amir Jokar, Ph.D., P.E., Member, David Anderson, Ph.D., P.E., Michael Cundy, Ph.D., P.E. and Russell Ogle, Ph.D., P.E., Exponent, Inc., Menlo Park, CA

2. Accelerated Life Methodology for Determining Acceptable Chemical Reactivity in HVACR Systems (AT-2019-C064)
Stephen Kujak, Member and Elyse Sorenson, Associate Member, Trane, Ingersoll Rand, La Crosse, WI

3. Impacts of Defrosting Air Cooling Coils (AT-2019-C065)

Donald Cleland, Ph.D., Fellow ASHRAE¹, Douglas Reindl, Ph.D., P.E., Fellow ASHRAE², Richard Love, Ph.D., Associate Member¹ and Todd Jekel, Ph.D., P.E., Member², (1)Massey University, Palmerston, New Zealand, (2)Industrial Refrigeration Consortium, Madison, WI

4. Improved Control of Condensers (AT-2019-C066)

Richard Love, Ph.D., Associate Member¹, Donald Cleland, Ph.D., Fellow ASHRAE¹, Douglas Reindl, Ph.D., P.E., Fellow ASHRAE² and Todd Jekel, Ph.D., P.E., Member², (1)Massey University, Palmerston, New Zealand, (2)Industrial Refrigeration Consortium, Madison, WI

11:00 AM - 12:30 PM

Conference Paper Session 20 (Intermediate)

Energy Efficient Ventilation

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B313b

Chair: Alamelu Brooks, Member, ICF International, Columbia, MD

Designing energy efficiency into proper ventilation system to meet ASHRAE standards must be considered in HVAC design. This session illustrates advances in ventilation design to meet new and improved standards like ASHRAE Standard 62.1-2016.

1. Performance Evaluation of Energy-Efficient Hybrid Ventilation Systems for Office Buildings (AT-2019-C067)

Hisaya Ishino, Ph.D., Member¹, Fumio Nohara², Isao Makimura³, Kimiko Kohri, Ph.D., Member⁴ and Shuzo Murakami, Ph.D., Fellow ASHRAE⁵, (1)Tokyo Metropolitan University, Tokyo, Japan, (2)Nikken Sekkei, Tokyo, Japan, (3)Naguwashi E&TP Laboratory, Kawagoe, Japan, (4)Utsunomiya University, Utsunomiya, Japan, (5)Institute for Building Environment and Energy Conservation, Tokyo, Japan

2. Simulation Study of Infiltration Effects on CO₂-Based Demand Controlled Ventilation System with High-Variant Occupancy Schedules (AT-2019-C068)

Siliang Lu, Erica Cochran Hameen, Ph.D. and Omer Karaguzel, Carnegie Mellon University, Pittsburgh, PA

3. Further Simplifying ASHRAE Standard 62.1 for Application to Existing Buildings: Comparing Informative Appendix D and Section 6.2.5.3 with Real-World Data (AT-2019-C069)

Meghan McNulty, P.E., Associate Member, Barry Abramson, P.E., CPMP and BEAP, Member and Pamela Moua-Vargas, Associate Member, Servidyne, LLC, Atlanta, GA

4. Temporal Analysis of Wind Data for Wind Driven Ventilation Assessment (AT-2019-C070)

Yun Zhang, Student Member, James Lo, Ph.D., Member and Sheng Wang, Student Member, Drexel University, Philadelphia, PA

11:00 AM - 12:30 PM

Seminar 69 (Intermediate)

Climate Change Liability for Owners, Designers and Manufacturers

Track: The Engineer's Role in Architecture

Room: Building B, B407

Sponsor: 2.5 Global Climate Change, TG2, TRG9, MTG.HCDH, TC4.1, TC4.2, TC7.6

Chair: Elizabeth Tomlinson, P.E., Member, U.S. General Services Administration, Washington, DC

ASHRAE provides guidance on use of climatic data in designs and facility assessments. Currently, the vast majority of design firms use historic climate files. This practice aligns with professional standard of care. However, given the international consensus that climate is changing, use of historic weather data in designs could lead to underperforming systems or building failures. Projected weather files from regional climate models include their own uncertainty and risk. This puts architects, engineers, owners and manufacturers in a difficult situation. This session covers climate change science, risks associated with various weather file use and changing standards of care.

1. US National Climate Assessment

Kenneth Kunkel, Ph.D., NOAA, North Carolina Institute for Climate Studies, Asheville, NC

2. ASHRAE TC4.2 Climatic Information Uncertainties: Historic Vs Projected Data

Drury Crawley, Ph.D., BEMP, Fellow ASHRAE, Bentley Systems, Inc., Washington, DC

3. Climate Change Liability

Kevin Haroff, Esq., J.D., Marten Law, San Francisco, CA

4. Safeguarding Assets for a Robust and Relevant Practice

Ann Kosmal, F.A.I.A., LEED AP BD +C, CPHC, PDC, U.S. General Services Administration, Washington, DC

11:00 AM - 12:30 PM

Seminar 70 (Intermediate)

Development of High-Reliability, Low-Cost, Occupancy Presence, Counting and CO2 Sensor Technologies and ASHRAE Testing Standards/Guidelines

Track: The Convergence of Comfort, IAQ, and Energy Efficiency Building

Room: Building B, B309

Sponsor: 7.5 Smart Building Systems

Chair: Kristen Cetin, Ph.D., P.E., Associate Member, Iowa State University, Ames, IA

Current nationwide efforts by universities, companies and research labs through ARPA-E's SENSOR (Saving Energy Nationwide in Structures with Occupancy Recognition) program include the development of user-transparent low-cost, high accuracy occupancy sensing systems that quantify human presence to significantly reduce building energy use. These projects include development of occupancy presence, occupancy counting and CO2 sensors, with the overall goal of 30% reduction in HVAC energy use. This seminar covers the SENSOR program and projects for residential and commercial buildings and the need and ongoing efforts to develop ASHRAE standards and/or guidelines for standardized testing of occupancy sensing technologies.

1. ARPA-E SENSOR Program Overview and Goals: Development of High-Reliability, Low-Cost Occupancy Sensor Development and Testing

Jennifer Gerbi, Ph.D., ARPA-E, Washington, DC

2. Commercial and Residential Building Occupancy Presence and Counting Sensor Technologies: Goals and Efforts to Date

Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

3. Innovative CO2 Sensor Development for Commercial Buildings: Goals and Efforts to Date

Jeff Rhoades, Ph.D., Purdue University, West Lafayette, IN

4. Development of Guidelines/Standards for Occupancy Sensor Testing: ASHRAE's Role

Kristen Cetin, Ph.D., P.E., Associate Member, Iowa State University, Ames, IA

11:00 AM - 12:30 PM

Seminar 71 (Intermediate)

How to Ensure that Your Building Control Improvements Actually Last

Track: Construction, Operation, and Maintenance of High Performance Systems

Room: Building B, B315

Sponsor: 7.6 Building Energy Performance

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

Do the improvements and retrofits that we make to building controls actually persist over time? This seminar explores that question for a number of different scenarios including retrocommissioning, new building commissioning and general retrofit of building automation. Results from primary research on the subject are presented as well as first-hand accounts from controls and commissioning contractors in the field. The session also demonstrates methods for improving persistence, including longer term activities like monitoring.

1. Key Steps to Improving Persistence of Commissioning

Jeff Stein, P.E., Member, Taylor Engineering, LLC, Alameda, CA

2. Observations and Results from a Field Study of Retrocommissioning Persistence

Xiaohui Zhou, Ph.D., Member, Seventhwave, Madison, WI

3. Stories from the Field: Working with Facility Managers Toward Persistent Improvements

Jason Jones, Member, Aerobuild, Chicago, IL

4. Persistence of Savings Isn't a Side Issue: Using New Tech to Make Sure Savings Show Up at the Meter

Jim Kelsey, P.E., BEAP, Member, kW Engineering, Oakland, CA

11:00 AM - 12:30 PM

Workshop 8 (Intermediate)

How to Model Thermal Bridging Using Clear Transmittance Method

Track: The Engineer's Role in Architecture

Room: Building B, B313a

Sponsor: 4.4 Building Materials and Building Envelope Performance

Chair: Wahid Maref, Ph.D., Member, ETS-Montreal, Montreal, QC, Canada

Many energy standards, heat loss calculations and whole building simulations overlook thermal bridging or use simplified building envelope details when calculating the overall thermal performance of a wall. This often neglects significant contributions to heat loss such as intersections between building envelope components, window to wall connections, floor interface and others that have thermally conductive materials bypassing the thermal insulation.

1. Improving Heat Loss Calculations Using Linear Transmittance

Peter Adams, P.Eng., Member, Morrison Hershfield, Thornhill, ON, Canada

2. Thermal Bridges

Chris Schumacher, Member, RDH Building Science Laboratories, Waterloo, ON, Canada