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Sunday, June 29

8:00 AM-9:00 AM

SEMINAR 1 (INTERMEDIATE)

I've Met All the Standards and People are Still Complaining: Now What Do I Do?



Track: Indoor Environment – Health, Comfort and Productivity Room: 603

Sponsor: SGPC 10, Environmental Health Committee

Chair: Eric W. Adams, Ph.D., Member, Carrier, Syracuse, NY

It may not be enough to meet environmental standards individually. The quality of the environment is driven by interactions among factors that are often considered unrelated. Understanding the interactions of indoor air quality (IAQ), thermal environment, noise and light within the built environment is critical for achieving occupant satisfaction within buildings. For example, humidity has IAQ perception, contaminant control and thermal comfort effects that are covered discretely in ASHRAE Standards 62, Ventilation for Acceptable Indoor Air Quality, and 55, Thermal Environmental Conditions for Human Occupancy, but in very different ways. Materials and systems used to address one problem may cause or may help another. This seminar provides examples of interactions and IEQ concerns that arise even when the basic environmental acceptability standards are met.

1. Saving Too Much Energy?

Mark Jackson, University of Texas - Austin, Austin, TX

2. My Building is So Cold in Summer and So Hot in Winter – What's Going On?

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

8:00 AM-9:00 AM

SEMINAR 2 (BASIC)

Step 1: Assessing a Project Site for Geothermal Heat Pump Applications



Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications, NGWA

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

The first step on geothermal heat pump projects is assessing project sites for ground heat exchanger viability. This includes understanding the local regulatory requirements, permitting and hydrogeology. It also requires design engineers to estimate through calculation or testing the local formation properties and the size and type of ground heat exchanger. The speakers in this session discuss the science and engineering for selecting and developing site data application for designing ground heat exchangers on commercial projects.

1. Site Characterization for Geothermal Heat Pump Systems

John Rhyner, PW Grosser Consulting, Bohemia, NY

2. Ground Heat Exchanger Design Considerations for Proper Integration with the Building System

Warren (Trey) Austin III, P.E., Member, Geo-Energy Services, Littleton, CO

8:00 AM-9:00 AM

SEMINAR 3 (BASIC)

Sustainable Career Design: A Holistic Approach

Track: Professional Skills

Room: 611

Chair: Richard King, P.E., Member, Peninsula Engineering, Orlando, FL

Just as sustainable buildings require a holistic approach for success, so do sustainable careers. An overall vision and specific goals need to be well defined. All systems – personal life, professional life, family life – interact so

maintaining proper balance requires careful planning as well as continual maintenance. Technical competency as well as soft skills must be considered. This seminar evaluates how to define a sustainable career and how to maintain work-life balance as challenges are encountered. Motivation, natural abilities, personality types and interpersonal relationship are discussed as they impact individual careers.

1. Design & Construction: Defining Your Sustainable Career

Megan M Tosh, P.E., Member, Integrated Environmental Solutions, Atlanta, GA

2. Operation & Maintenance – Career Awareness and Adaptation

Nathan Kegel, Member, Integrated Environmental Solutions, Plymouth, MN

8:00 AM-9:00 AM

WORKSHOP 1 (INTERMEDIATE)

Development of an ASHRAE Energy Guideline for Historical Buildings



Track: Standards, Guidelines and Codes

Room: 609

Sponsor: 04.04 Building Materials and Building Envelope Performance, Historical Committee, GPC 34, 01.12 Moisture Management in Buildings

Chair: David Arnold, Ph.D., Fellow Life Member, London South Bank University, London, United Kingdom

ASHRAE is preparing a guideline for use by architects, engineers and building owners for the energy efficient preservation or rehabilitation of historic buildings. The proposed guideline will focus on design, operation and maintenance of energy-using systems that do not compromise historical preservation. The guidance will include advice, recommendations and sources of further information for: envelope rehabilitation and restoration; energy efficient HVAC systems that provide acceptable indoor environmental quality, and energy efficient lighting. The workshop has two brief presentations on successful energy efficient rehabilitations of historic buildings and a 45 minute question and answer session with a panel of four experts.

1. Refurbishment of 100 Year Old Neo Classic Office Building, Athens, Greece

Constantinos A. Balaras, Ph.D., P.E., Member, Institute of Environmental Research and Sustainable Development, Athens, Greece

2. Wayne Aspinall Federal Courthouse: U.S. General Service Administration's (GSA) First Net Zero Energy Building Is Also a Historic Building

Martin Weiland, P.E., Member, General Services Administration, Washington, DC

8:00 AM-9:00 AM

WORKSHOP 2 (INTERMEDIATE)

Effects of Contaminants on Refrigeration System Performance

Track: Refrigeration

Room: 612

Sponsor: 03.03 Refrigerant Contaminant Control

Chair: Warren Clough, Member, Carrier Corp., Syracuse, NY

Contaminants in a HVAC&R system can be detrimental and, at some point, impact the performance and reliability or eventually lead to a catastrophic failure. There are standards in place to minimize the level of contaminants that enter into a system. For example, Air Conditioning, Heating and Refrigeration Institute (AHRI) 700, Specification for Fluorocarbon Refrigerants, is an industry standard that controls the level of refrigerant impurities. Should a system become contaminated there are products designed to remove and control the levels allowed. Some contaminants introduced cannot be system controlled and have resulted in fatalities. Therefore, steps have to be taken to avoid such contaminants from being introduced.

1. Various System Contaminants, their Sources, and Tools to Eliminate Them

Christopher Reeves, Associate Member, Parker Hannifin Corporation, Washington, MO

2. Updates to AHRI 700 Specification for Refrigerants and the Level of Acceptable Impurities

Robert W. Yost, Member, National Refrigerants, Rosenhayen, NJ

8:00 AM-9:00 AM

WORKSHOP 3 (INTERMEDIATE)

Exergy: Exposing the Flaw in Energy Conservation as an Exclusive Solution to Sustainability



Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 07.04 Exergy Analysis for Sustainable Buildings, 06.05 Radiant Heating and Cooling

Chair: Robert Bean PL(Eng.) R.E.T., Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

This workshop is an introduction to exergy and an exergy management model-based carbon dioxide emissions calculation that may be instrumental in expanding the carbon dioxide analysis view in ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings. Discussion follows to expand upon basic fundamentals and applications.

1. The ABC's of Exergy

Robert Bean PL(Eng.) R.E.T., Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

2. Exergy Dimension of Carbon Dioxide Analysis and Standard 189.1

Birol Kilkis, Ph.D., Fellow ASHRAE, Baskent University, Ankara, Turkey

8:00 AM-9:00 AM

WORKSHOP 4 (INTERMEDIATE)

Optimizing Variable Refrigerant Flow Content in the ASHRAE Handbook: HVAC Systems and Equipment

Track: HVAC&R Systems & Equipment

Room: 607

Sponsor: 08.07 Variable Refrigerant Flow

Chair: Douglas K. Tucker, Member, Mitsubishi Electric Cooling & Heating, Suwanee, GA; Andrew Moore, Associate Member, Mitsubishi Electric, Duluth, GA

VRF remains a hot topic with high interest levels. The session is intended to review the current VRF chapter in the ASHRAE Systems and Equipment Handbook with attendees to define areas that need clarification and/or improvement. The current chapter represents the first time that VRF was officially presented to the engineering community in the Handbook. The various sections of the VRF chapter are represented in a PowerPoint presentation to facilitate the discussion about the key areas of system type, system operation, and system design and installation. Also, the current state of VRF in the industry is presented.

1. Optimizing VRF Content in the Systems Handbook

Paul L. Doppel, Mitsubishi Electric, Suwanee, GA

2. Optimizing VRF Content in the Systems Handbook

Brian Bogdan, LG Electronics, Alpharetta, GA

8:00 AM-9:00 AM

WORKSHOP 5 (INTERMEDIATE)

Getting the Right Data into and out of Building Information Model



Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606

Sponsor: 07.03 Operation and Maintenance Management, 01.05, 04.01, SGPC 20, 04.01 Load Calculation Data and Procedures

Chair: Robert J. Hitchcock, Member, Hitchcock Consulting, Kelsey, CA

Getting the right data into and out of a building information model requires properly defining work flows. Getting work flows right requires input from BIM experts and ASHRAE professionals. This interactive workshop presents an overview of the BIM work flow specification process, then breaks out into working groups to review drafts of operations and maintenance work flows for ASHRAE Guideline 4, Preparation of Operating and Maintenance Documentation for Building Systems; Service Life and Maintenance Cost Database; ASHRAE Standard 105, Standard Methods of Determining, Expressing and Comparing Building Energy Performance and

Greenhouse Gas Emissions; ASHRAE/ACCA Standard 180, Standard Practice for Inspection and Maintenance of Commercial-Building HVAC Systems; and the Performance Measurement Protocols publications. Come share your experiences and tell us what we are getting wrong.

1. Overview of the BIM Work Flow Specification Process

Robert J. Hitchcock, Member, Hitchcock Consulting, Kelsey, CA

2. Providing Subject Matter Expert Feedback on BIM Work Flows

Steve Bruning, P.E., Fellow ASHRAE, Newcomb & Boyd, Atlanta, GA

9:00 AM-9:45 AM

NETWORKING COFFEE BREAK

(In front of 6B)

Grab some coffee and network with your fellow ASHRAE conference attendees after the opening sessions. This is a great chance to discuss the program and form connections to make the most of your time in Seattle.

9:45 AM-10:45 AM

TECHNICAL PLENARY

Bullitt Center: A Net Positive Building That Functions

Like A Tree – Denis Hayes, President and CEO, Bullitt Center

Room: Ballroom 6B

This Technical Plenary discusses the problems and opportunities associated with “net positive” commercial construction, using the Bullitt Center as an illustration of what is currently possible. Hayes is probably best known for having been national coordinator of the first Earth Day when he was 25. Internationally, he is recognized for having expanded Earth Day to more than 180 nations. During the administration of former U.S. President Carter, Hayes directed the federal National Renewable Energy Laboratory. At the Bullitt Foundation, Hayes leads an effort to mold the American Pacific Northwest into a global model of sustainability.

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 1 (INTERMEDIATE)

Theoretical Approaches to Air Quality for Specific Locations and Two Phase Flow Through Pipe

Track: HVAC&R Fundamentals and Applications



Room: 608

Chair: *Jennifer E. Leach, P.E., Member, Cummins-Wagner Co, Inc., Annapolis Junction, MD*

Air quality issues can vary greatly depending on the requirements for a given location. This session presents theoretical methods for determining the effects on air quality by various contaminants and theoretical methods of assessment. This session also presents a theoretical method for determining two phase media through pipe.

1. Methods for Calculation of Evaporation from Swimming Pools and Other Water Surfaces (SE-14-001)

Mirza Shah, Consultant, Redding, CT

2. Phase Splitting Algorithm for Ice Slurry Flow Pressure Drop in Straight Pipe Flow (SE-14-002)

Tengfei Zhang, Ph.D., Member, Dalian University of Technology, Dalian, China

3. Determination of the Effect of Humidity on the Probability of Electrostatic Discharge Failure or Upset in Data Centers (SE-14-003)

Mahdi Moradian, Missouri University of Science and Technology, Rolla, MO

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 1 (INTERMEDIATE)

Ground Source Heat Pump System Performance Case Studies in Different Climates Around the World

Track: *Ground Source Heat Pumps: State of the Art Design, Performance and Research*

Room: Ballroom 6B

Sponsor: *06.08 Geothermal Heat Pumps and Energy Recovery Applications*



Chair: *Jeffrey Spitler, Ph.D., P.E., Oklahoma State University, Stillwater, OK*

Presentations include a description of a novel residential hybrid GSHP system, studies of system performance for a range of climates and system designs and new experimental measurements of a system in an arctic environment.

1. Ground Source Heat Pump Efficiency in Cold Climates (SE-14-C001)

Robbin L. Garber-Slaght, P.E., Associate Member¹, Ronald Dannen, Ph.D.² and Andrew Roe³, (1)Cold Climate Housing Research Center, Fairbanks, AK, (2)Alaska Department of Natural Resources, Fairbanks, AK, (3)Alaska Geothermal LLC, Fairbanks, AK

2. Development of a Renewable Ground Loop System (SE-14-C002)

Toshiyuki Hino, Dr.Eng., Affiliate and Ryoza Ooka, Dr.Eng., Associate Member, The University of Tokyo, Tokyo, Japan

3. Evaluation of the Applicability of Heat Pump Systems in Residential Buildings with Different Insulation Standard Located in Different Climate Regions in the U.S. (SE-14-C003)

Lars P. Junghans, Dr.Eng., Associate Member, University of Michigan, Ann Arbor, MI

4. Economic Analysis of Ground Source Heat Pumps in North Carolina (SE-14-C004)

Miriam Makhyoun, Hamed Honari, Student Member, Vikram Sridhar and Kacey Hoover, North Carolina Sustainable Energy Association, Raleigh, NC

5. Effect of Residential Ground Source Heat Pump System Design on Emissions in Sweden (SE-14-C005)

Jeffrey Spitler, Ph.D., P.E.¹, Amy Wong, Student Member¹ and Signhild E. A. Gehlin, Ph.D., Member², (1)Oklahoma State University, Stillwater, OK, (2)Swedish Centre for Shallow Geothermal Energy, Lund, Sweden

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 2 (INTERMEDIATE)

Indoor Environmental Quality Analysis of Healthcare, Clean Room, Residence and Vehicular Applications

Track: *Indoor Environment – Health, Comfort and Productivity*



Room: 603

Sponsor: *09.11 Clean Spaces, 09.06 Healthcare Facilities*

Chair: *Hyojin Kim, Ph.D., Member, The Catholic University Of America, Washington, DC*

The exhaled air of infected people can be a source of pollutants and respiratory viruses. The exhaled air comes from respiratory events such as the breathing, coughing, sneezing and talking. A new ventilation concept, known as protected occupied zone ventilation (POV), was developed to protect people from epidemic respiratory diseases. This session challenges the requirements of current ventilations codes with performance based demand control ventilation alternatives for healthcare and mini-environment and clean rooms. The session presents a new approach with periodic reversible supply and exhaust air for vehicular spaces. A total energy recovery ventilator prototype integrating heat recovery with an airside economizer control is presented for residences.

1. Analysis of Air Change Rates and System Configuration on the Performance of a Mini-Environment Cleanroom (SE-14-C007)

Kishor Khankari, Ph.D., Member, AnSight LLC, Ann Arbor, MI

2. A Simultaneous Consideration Of Energy and Ventilation In Healthcare (SE-14-C008)

Travis R. English, P.E., Member, Kaiser Permanente, Oakland, CA

3. Feasibility Study of an Innovative and Compact Residential Heat Recovery Ventilator/Energy Recovery Ventilator/Economizer Based Ventilation System (SE-14-C009)

Agustin Olt, Student Member, Jun Zhang and Alan Fung, Ryerson University, Toronto, ON, Canada

4. Experimental Study of the Cross Infection Risk Due to the Cross-Flow of Exhaled Airflows and a Plane Jet with the Protected Occupied Zone Ventilation (SE-14-C010)

Guangyu Cao, Ph.D., Associate Member¹, Peter V. Nielsen, Ph.D.², Chunwen Xu³ and Rasmus L. Jensen, Ph.D.², (1)VTT Technical Research Centre of Finland, Espoo, Finland, (2)Aalborg University, Aalborg, Denmark, (3)Hunan University, Changsha, China

5. Integral Design a New Necessary Professional Skill for Architect and HVAC-Engineers to Cope with Their New Roles for Sustainable Development (SE-14-C006)

Wim Zeiler, TU Eindhoven, Eindhoven, Netherlands

6. Assessment of the Indoor Environmental Quality in a Dutch Daycare Center (SE-14-C011)

Mark de Waard¹, Wim Zeiler¹ and Froukje van Dijken², (1)TU Eindhoven, Eindhoven, Netherlands, (2)BBA, Rotterdam, Netherlands

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 3 (ADVANCED)

Simulation Model Development for Building Control and Operation

Track: Research Summit

Room: 612

Sponsor: 01.04 Control Theory and Application, 07.05 Smart Building Systems

Chair: Jin Wen, Ph.D., Member, Drexel University, Philadelphia, PA

Four conference papers focusing on the development, validation and calibration of building energy and dynamic system simulation models are presented in this session. The presented simulation models include new testbeds used to study and develop building control, operation and fault diagnosis strategies; and new energy forecasting models. Real building measurements are used in most of the studies to validate or calibrate the models. Utilization of such testbeds and models for building control and operation is discussed.

1. Tools for Evaluating Fault Detection and Diagnostic Methods for Fan Coil Unit (SE-14-C012)

Shokouh Pourarian, Ph.D.¹, Jin Wen, Ph.D.¹, Daniel Veronica, Member², Xiaohui (Joe) Zhou³ and Ran Liu, Ph.D., Student Member⁴, (1)Drexel University, Philadelphia, PA, (2)National Institute of Standards and Technology, Gaithersburg, MD, (3)Iowa Energy Center, Ames, IA, (4)Iowa Energy Center, Ankeny, IA

2. Net Zero Energy Impact Building Clusters Emulator for Operation Strategies Assessment (SE-14-C013)

Xiwang Li, Student Member and Jin Wen, Ph.D., Member, Drexel University, Philadelphia, PA

3. Development of a Probabilistic Graphical Energy Performance Model for an Office Building (SE-14-C014)

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

11:00 AM-12:30 PM

SEMINAR 4 (ADVANCED)

Cooling Potential with Increased Night Ventilation in Low Energy Buildings

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606

Sponsor: 06.03 Central Forced Air Heating and Cooling Systems, TC4.3 and , 02.01 Physiology and Human Environment

Chair: Max Sherman, Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA

In post-occupancy studies of low energy buildings, elevated temperature levels is a commonly reported problem. Ventilative cooling can be an attractive and energy efficient solution to reduce peak load and energy use in new and existing residential buildings. Equipment required for ventilative cooling in residential buildings is available and has been shown to be cost-effective in many climates. The seminar presents the concept of ventilative cooling together with studies of the potential impact on energy consumption and indoor environment in different climatic regions.

1. Ventilative Cooling Needs and Outdoor Night Cooling Potential Per Heiselberg, Aalborg University, Aalborg, Denmark

2. Evaluation of Different Concepts for Ventilative Night Cooling by Building Simulations

Angela Simone, Ph.D., Member, Denmark Technical University, Kgs. Lyngby, CA, Denmark

3. Residential Ventilative Cooling Technology Status and Applications

David Springer, Member, Davis Energy Group, Davis, CA

11:00 AM-12:30 PM
SEMINAR 5 (INTERMEDIATE)

IT Equipment Power and Cooling Trends and Deployment Best Practices

Track: HVAC&R Systems & Equipment

Room: 607

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: Nick Gangemi, Member, Facility Gateway Corp, Penfield, NY

IT equipment power and cooling trends continue to push the limits in the industry, primarily due to packaging density, high performance computing and mass scale out deployment. The challenges associated with supporting these technologies in a data center environment is becoming more pressing than ever before, not only from a power perspective, but also from an airflow delivery perspective. This seminar highlights the latest power and cooling trends, and then focuses on associated deployment best practices at the server level, while evaluating the existing and emerging room level cooling solutions and technologies.

1. IT Equipment Power and Cooling Trends and Deployment Best Practices

Jason Matteson, IBM, Ney York, SC

2. IT Equipment Power and Cooling Trends and Deployment Best Practices

Robin Steinbrecher, Intell, NY, NY

3. IT Equipment Power and Cooling Trends and Deployment Best Practices

David Moss, Dell, Inc., Austin, TX

11:00 AM-12:30 PM

SEMINAR 6 (INTERMEDIATE)

Vivarium Environment: Objectives, Requirements and Possibilities

Track: Indoor Environment – Health, Comfort and Productivity

Room: 611

Sponsor: 02.02 Plant and Animal Environment, 09.10 Laboratory Systems

Chair: James Coogan, P.E., Member, Siemens, Buffalo Grove, IL

Indoor environmental requirements for an animal research facility are driven by a complex of special objectives. In addition to the health and comfort of the workers, designers must address the living environment of the animals. This includes all thermal comfort variables, air contamination and daily lighting patterns. Improper animal environment can undermine research and destroy productivity. The seminar discusses basic objectives, current standards, traditional design approaches and new technical solutions.

1. Laboratory Animal Facility Guidelines and Effective Air Change Rates

Carol Donovan, Associate Member, Sebesta Blomberg & Associates, Woburn, MA

2. Slashing Vivarium Energy Use By up to 50%

Gordon Sharp, Member, Aircuity, Inc., Newton, MA

3. Assuring Environmental Conditions for Animal Research

Paul Fuson, Member, Siemens Industry Inc., Buffalo Grove, IL

11:00 AM-12:30 PM

SEMINAR 7 (INTERMEDIATE)

Update on ASHRAE's Expanded and Enriched Green Building Tools

Track: Standards, Guidelines and Codes

Room: 609

Sponsor: 02.08 Building Environmental Impacts and Sustainability

Chair: Janice K. Means, P.E., Member, Lawrence Technological University, Southfield, MI

Attendees are alerted to the latest revisions to noteworthy ASHRAE publications recognized as significant tools in the design and operation of high performance buildings. All chapters of the 4th edition of ASHRAE GreenGuide have been revised with chapters on indoor environmental quality and architecture completely rewritten and a new chapter on Sustainable Sites

added. ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings, has been fine-tuned to specify greater energy savings and other changes as green building technologies evolve. The newest set of the Advance Energy Design Guides now boasts saving 50% energy improvement over that specified by ANSI/ASHRAE/IES Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings.

1. Changes to Standard 189.1 - Standard for the Design of High Performance Green Buildings

T.M. Lawrence, Ph.D., P.E., Member, University of Georgia, Athens, GA

2. Advanced Energy Design Guides: Leading the Way for Energy Savings

Paul A. Torcellini, Ph.D., Member, National Renewable Energy Laboratory, Golden, CO

3. What's New in the 4th Edition of the ASHRAE GreenGuide?

T.M. Lawrence, Ph.D., P.E., Member, University of Georgia, Athens, GA

1:00 PM-2:00 PM

FORUM (INTERMEDIATE)

Is it Time for a Scope Change Between the ASHRAE Ventilation and IAQ Standards 62.1 and 62.2?

Track: Indoor Environment – Health, Comfort and Productivity

Room: Grand Ballroom A – Sheraton

Sponsor: SSPC 62.1 and SSPC 62.2

Chair: Hoy R. Bohanon, P.E., Member, WorkingBuildings, Clemmons, NC

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. ASHRAE Standard 62 Ventilation for Acceptable Indoor Air Quality was divided into two standards (62.1 and 62.2) a decade ago. The scope was differentiated based on the building use and height. Residential occupancies in buildings 3 stories in height or less are covered by 62.2 and almost all other building spaces are covered by 62.1. This results in some differences in ventilation requirements for residential spaces depending on the height of the building. Should Standard 62.2 cover all residential occupancies? What would be the advantages? How would such a change affect other standards such as 90 and 189?

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 2 (INTERMEDIATE)

Analysis and Modeling of Unitary and Room Air Conditioners and Heat Pumps

Track: Refrigeration

Room: 609

Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps

Chair: Ann Peratt, Associate Member, PKMR Engineers, Overland Park, KS

This session evaluates energy savings and economic potential for unitary and room air conditioners and heat pumps.

1. Staging Packaged Air Conditioning Units to Improve Energy Efficiency and Humidity Control by Reducing Cycling Losses (SE-14-004)

Seth Parker, University of Dayton, Dayton, OH

2. Engineering and Economic Analysis of Air Conditioners in the Kingdom of Saudi Arabia – Upgrading the Minimum Energy Performance Standards (SE-14-005)

John P. Proctor, P.E., Member and Abram W. Conant, Member, Proctor Engineering Group, San Rafael, CA

3. Generalized Performance Maps for Single and Dual Speed Residential Heat Pumps (SE-14-006)

Simbarashe Nyika, Student Member and Seth O. Holloway, Student Member, Purdue University, West Lafayette, IN

4. Generalized Performance Maps for Variable Speed Ducted Residential Heat Pumps (SE-14-007)

Simbarashe Nyika, Student Member and Seth O. Holloway, Student Member, Purdue University, West Lafayette, IN

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 3 (INTERMEDIATE)

Super Insulated Retrofit Strategies, Climatic Design Conditions and Convection Enhancements

Track: Research Summit

Room: 608

Sponsor: 04.04 Building Materials and Building Envelope Performance, 04.01 Load Calculation Data and Procedures

Chair: Juan-Carlos Baltazar, Ph.D., Texas A&M University, College Station, TX



This session begins with analysis of the climatic data utilized to determine building HVAC loads. The next two presentations explore insulation strategies needed to keep occupants comfortable. The final speaker presents formation to enhance surface convection.

1. Thermal Design of Window-Wall Interface in Wall Energy Retrofits Using High Performance Vacuum Insulation (SE-14-008)

Jan Kosny, Ph.D., Member, Sustainable Energy Systems, Cambridge, MA

2. Experimental and Numerical Investigation of Surface Convection Enhancement by a V-Formation Delta-Winglet Array in a Developing Channel Flow (SE-14-009)

Jing He, Ph.D., Heatcraft Worldwide Refrigeration, Lawrenceville, GA

3. Energy Codes and the Evolution of Fenestration: 20 Years of NFRC Ratings in Seattle (SE-14-010)

John Hogan, P.E., Member, Consultant, Seattle, WA

4. Temperature Trends for Locations Listed in the Tables of Climatic Design Conditions in the 2013 Handbook – Fundamentals (SE-14-011)

Didier Thevenard, Ph.D., P.E., Member, Numerical Logics Inc., Waterloo, ON, Canada

1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 4 (INTERMEDIATE)

Refrigeration Research Advancements and the Application to Heat Pump and Transport Systems

Track: Refrigeration

Room: 612

Chair: Pam Androff, Associate Member, Mitsubishi Electric, Atlanta, GA

This session presents a number of studies in refrigeration research including low global warming potential (GWP) refrigerants on heat pump systems, carbon dioxide compatibility as a refrigerant and the measurement of nanoparticle concentration in binary liquids. The session also addresses the lifecycle performance for transport refrigeration and the system damages that occur from spike pressures and shock waves.

1. Refrigeration Systems Failures Due to Sudden Evaporation and Condensation Processes (SE-14-C015)

Amir Jokar, Ph.D., P.E., Member, Erik W. Christiansen, Ph.D., P.E. and Ali Reza, P.E., Exponent Inc. Thermal Sciences Practice, Los Angeles, CA

2. Life Cycle Climate Performance Model for Transport Refrigeration/Air Conditioning Systems (SE-14-C016)

Dennis M. Nasuta, Associate Member¹, Robert Srichai, Member², Ming Zhang, Ph.D., Member¹, Cara Martin, Associate Member¹ and Jan Muehlbauer, Member¹, (1)Optimized Thermal Systems, LLC, College Park, MD, (2)Ingersoll Rand, Minneapolis, MN

3. Stability of Candidate Lubricants for Carbon Dioxide Refrigeration (SE-14-C017)

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

4. Concentration Measurement Technique of Binary Liquids Containing Colloidal Suspension of Nanoparticles (SE-14-C018)

Maryam Fahar, Student Member and Todd Otanicar, Ph.D., Member, The University of Tulsa, Tulsa, OK

5. The Influence of Climate Conditions on Life Cycle Climate Performance of Low GWP Refrigerant Based Heat Pumps (SE-14-C019)

Pavel Makhnatch and Rahmatollah Khodabandeh, KTH Royal Institute of Technology, Stockholm, Sweden



1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 5 (INTERMEDIATE)

Evaluation and Optimization of Variable Refrigerant Flow Systems, Fan Coil Units, Packaged Terminal Air Conditioning Unit Fan Blowers, Variable Speed Compressor Heat Pumps and Chiller Plant Components

Track: HVAC&R Systems & Equipment



Room: 607

Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps, 06.01 Hydronic and Steam Equipment and Systems, 08.07 Variable Refrigerant Flow

Chair: Gary C. Debes, Member, Coward Environmental Systems, Coatesville, PA

Space temperature adjustment of a VRF system is evaluated with respect to thermal comfort and energy conservation. Fan coil fault detection and diagnostic method modeling results is described. Improvement in system energy performance as a result of using a blower at a lower speed to deliver the designed airflow is reported. The energy conservation benefits of variable speed compressors in heat pumps are introduced. Optimization of chiller plant components including single-stage centrifugal compressor, shell-and-tube evaporator and condenser, cooling tower with variable-speed fan and cooling water pump are described.

1. Effect of the Set-Point Temperature on Indoor Thermal Comfort and Energy Demand in Office Building (SE-14-C020)

Taeju Park, M.D., Student Member¹, Doosam Song, Ph.D., Member¹, Kinam Kang, Dr.Eng., Student Member¹, Gyumin Kang, Dr.Eng., Student Member¹, Brain S. Kim, Dr.Eng., Member² and Hyejung Cho, Ph.D.², (1) Sungkyunkwan University, Suwon, South Korea, (2) Samsung Electronics Co. Ltd., Suwon, South Korea

2. Impact of the Blower on the System Performance of a 5-Ton Air Conditioner (SE-14-C021)

Peng Yin, Student Member, James F. Sweeney, Associate Member and Michael Pate, Ph.D., P.E., Member, Texas A&M University, College Station, TX

3. Field Study of Performance, Comfort, and Sizing of Two Variable-Speed Heat Pumps Installed in a Single 2-Story Residence (SE-14-C022)

Jeffrey D. Munk¹, Adewale O. Odokumaiya², Anthony C. Gehl¹ and Roderick K. Jackson¹, (1) Oak Ridge National Laboratory, Oak Ridge, TN, (2) Georgia Institute of Technology, Atlanta, GA

4. Optimal Model-based Control of Chiller Tower Fan and Cooling Water Pump (SE-14-C023)

Omer A. Qureshi, Student Member, Hassan Javed, Affiliate, P.R. Armstrong, Ph.D., Member and Afshin Afshari, Ph.D., Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates

1:30 PM-3:00 PM

SEMINAR 8 (INTERMEDIATE)

Case Studies of Energy Reduction in Existing Buildings: Lessons Learned on How Involving Owners and Operators in Design and Execution Creates Successful Long Term Results

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings



Room: 606

Sponsor: 09.01 Large Building Air-Conditioning Systems

Chair: Rachel Romero, Associate Member, NREL, Golden, CO

This seminar presents three case studies illustrating how involving owners and operating/maintenance personnel during design and construction results in buildings that are more successful and perform better over the long term. When planning and designing for energy efficient systems, both new and retrofit projects benefit significantly from user and operator input. Operating and maintenance personnel have experiences that most designers do not. Their valuable insight is critical to a successful project, especially for integrated design and sustainability. A higher education laboratory, an electric company headquarters building and a government office building focus on lessons learned from the project.

1. Saving Energy in the Electric Company Headquarters Building, Rebuilding HVAC Systems while Occupied

John Kuempel Jr., P.E., Member, DeBra-Kuempel, Mechanical/Electrical, Cincinnati, OH

2. Commissioning and Maintaining a Building during a Floor-By-Floor Renovation

Steven Nicklas, EMCOR Government Services, Arlington, VA

3. Retrofits for Laboratory Buildings

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

1:30 PM-3:00 PM

SEMINAR 9 (INTERMEDIATE)

Demand Control Ventilation for Multiple Zone Variable Air Volume Systems: Problem Solved

Track: Indoor Environment – Health, Comfort and Productivity



Room: 603

Sponsor: 04.03 Ventilation Requirements and Infiltration

Chair: John J. Carter, Member, CPP, Inc., Fort Collins, CO

ASHRAE Research Project 1547, Carbon Dioxide-Based Demand Controlled Ventilation for Multiple Zone HVAC Systems, was conducted to develop and test DCV strategies. This seminar provides the background for the project and describes development of three control strategies. Energy and airflow mass balance simulations were conducted to test the performance of the three theoretical strategies.

1. The Background and Methodology for Simulating the Proposed CO2-Based Demand Control Ventilation Strategies (RP 1547)

Josephine Lau, Ph.D., Associate Member, University of Nebraska – Lincoln, Omaha, NE

2. The Proposed Control Strategies and their Corresponding Energy Performance (RP 1547)

Xingbin Lin, Ph.D., Associate Member, Nexant Inc., Wheaton, IL

3. A First Step: Resetting Outdoor-air Intake Flow Based on Zone DCV and System Ventilation Efficiency

Dennis Stanke, Life Member, Trane (Retired), LaCrosse, WI

4. DCV in Multiple Space Systems: Implementation in System Design and Controls

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

1:30 PM-3:00 PM

SEMINAR 10 (INTERMEDIATE)

GEO 2.0: From the Ground Up, an Overview of the Updated ASHRAE Ground Source Heat Pump (GSHP) “Blue Book”

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research



Room: Ballroom 6B

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: David Dinse, P.E., Member, Tennessee Valley Authority, Chattanooga, TN

The ASHRAE book, Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings, was published in 1997. Much has changed since 1997. ASHRAE Research Project 1674, Research to Support the Revision to Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings, provided new information not previously available to designers. Two new chapters include: a hydro-geological primer and overview of drilling methods; and a summary of recent field studies and listing of notable installations. New appendices cover topics of well testing, analysis, performance, drilling methods and problems. The authors present overview of the updated book and include example design procedures and demonstrations of spreadsheet software included with the book purchase.

1. HVAC Equipment and Closed Loop System Design

Steve Kavanaugh, Ph.D., Fellow ASHRAE, University of Alabama, Tuscaloosa, AL

2. Groundwater Systems, Hydrology and Wells

Kevin Rafferty, P.E., Member, Modoc Point Engineering, Klamath Falls, OR

1:30 PM-3:00 PM
SEMINAR 11 (ADVANCED)

Advances in Simulation Research for the Design and Operation of Natural and Mixed Ventilation Systems

Track: Research Summit

Room: 611

Sponsor: 04.10 Indoor Environmental Modeling, 04.07 Energy Calculations

Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL



Natural and mixed mode ventilations are considered to be an energy efficient way to provide building cooling. However, it is difficult to estimate and achieve the desired performance due to the complexity of the system. This seminar introduces advancements in simulation research to enable the optimized design and operation of buildings with natural and mixed mode ventilation.

1. Design and Advanced Air Flow Simulation of Naturally Ventilated Theatres

Malcolm J. Cook, Ph.D., Member, Loughborough University, Loughborough, United Kingdom

2. Natural and Mixed Ventilation Energy Efficiency Optimization Via Integrated CFD and Building Performance Simulation

Marija S. Todorovic, VEA-INVI.Ltd, Zug, Switzerland

3. Considering Wind Effects When Designing for Natural Ventilation

L. James Lo, Ph.D., National Institute of Standards and Technology/ University of Texas at Austin, Gaithersburg, MD

4. Energy Modeling and Predictive Control Strategies for Efficient Mixed-Mode Cooling Using Natural Ventilation

Panagiota Karava, Ph.D., Associate Member, Purdue University, West Lafayette, IN

2:15 PM-3:00 PM
FORUM (INTERMEDIATE)

Statistical Sampling in Commissioning

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: Metropolitan Ballroom B – Sheraton

Sponsor: 07.09 Building Commissioning, 07.07 Testing and Balancing

Chair: Lee Riback, Member, P2S Engineering, Long Beach, CA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. One driving force in the scope of commissioning effort is the quantity of equipment being field tested. Commissioning strategies vary in methods; some use statistical sampling, others test all equipment, while some others use software to analyze trend data. When sampling is used and results are poor, the percentage is typically increased, adding costs that may not be supported by the project team. This leads us to the question of "how much is enough?" We intend to promote a lively discussion with active audience participation in order to provide guidance to industry stakeholders.

2:45 PM-3:15 PM
SEMINAR (INTERMEDIATE)

An Application and Successful Story of Automated Fault Detection and Diagnostics

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 619

Sponsor: 07.05 Smart Building Systems

Chair: Xiaohui (Joe) Zhou, Ph.D., P.E., Member, Iowa Energy Center, Ames, IA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. Automated Fault Detection & Diagnostics is a powerful tool that engineers can utilize for building optimization and asset management. From building construction and occupation to ongoing optimization, it can be used as an aid for identifying and maintaining energy-saving opportunities and analyzing system performance over time. "Automatic Fault Detection and Diagnostics: An Engineering Tool For Building Operation and Optimization" by Darrell Smith, Microsoft, Redmond, WA, shows how Microsoft has taken AFDD to all aspects of a building's life – initiation, operation and optimization – uncovering value and creating insight for engineers and building operators.

3:15 PM-4:45 PM
SEMINAR 12 (INTERMEDIATE)

Ground Source Heat Pump System Case Studies

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research



Room: 603

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Keith Swilley, Member, Gulf Power Company, Pensacola, FL

University science buildings are typically the highest net energy users on a campus. This project combined a centralized geothermal heating/cooling plant, a dedicated outside air system, active chilled beams, thermally-massive radiant heating/cooling and self-learning adaptive controls. The system is designed to use geothermal loop water directly for sensible cooling without needing a chiller. A magnetic-bearing chiller provides chilled water for the dedicated outdoor air system (DOAS) unit and hot water for heating. Net onsite energy consumption for the first year of operation was 64 KBTU per square foot.

1. Geothermal HVAC Case Study: Davis Building, University of Findlay
Stephen A. Hamstra, P.E., Member, Greensleeves LLC, Zeeland, MI

2. Geothermal HVAC Case Study: Success in K-12 Schools and Nation's Largest Net Zero School

Don Penn, P.E., Member, Image Engineering Group, Ltd., Grapevine, TX

3. Geothermal HVAC Case Study: Fast Food Restaurant, Pensacola, FL
Greg Tinkler, P.E., Member, Redding Linden Burr Consulting Engineers, Houston, TX

Monday, June 30

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 4 (INTERMEDIATE)

Boreholes: Vertical Ground Heat Exchangers

Track: Research Summit

Room: 606

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

This session explores vertical ground heat exchanger spacing, configuration, depth, quality control and effects of weather.

1. Evaluation of the Thermal Performance of Two Non-Standard Borehole Configurations (SE-14-012)

Michel Bernier, Ph.D., Member, Ecole Polytechnique De Montreal, Montreal, QC, Canada

2. Effects of Unequal Borehole Spacing on the Required Borehole Length (SE-14-013)

Massimo Cimmino, Student Member and Michel Bernier, Ph.D., Member, Polytechnique Montréal, Montreal, QC, Canada

3. Quality Control Assessment of Vertical Ground Heat Exchangers (SE-14-014)

Jasmin Raymond, Ph.D., Centre Eau Terre Environnement, Couronne, QC, Canada

4. Effects of Weather Parameters on Vertical Ground Heat Exchanger Design (SE-14-015)

Farzin Rad, P.Eng., Member, Alan Fung, Ph.D., P.E., Member and Wey Leong, Ph.D., Ryerson University, Toronto, ON, Canada

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 5 (INTERMEDIATE)

Theoretical and Real World Application of Energy Saving Techniques

Track: HVAC&R Systems & Equipment

Room: 607

Sponsor: 06.02 District Energy, 06.05 Radiant Heating and Cooling

Chair: Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC



Energy conservation starts with theoretical calculations and then test cases for energy conserving technologies. This session describes some analytical methods for future technologies and a case study for a new technology designed for energy conservation.

1. Design, Installation and Results of Variable Frequency Drives at a Mid-Sized Power Generation Facility (SE-14-016)

James Mathias, Ph.D., P.E., Associate Member, and Scott Achelpol, Southern Illinois University, Carbondale, IL

2. Virtual Flow Meter to Estimate the Water Flow Rates in Chillers (SE-14-017)

Eric McDonald, Concordia University, Montreal, QC, Canada

3. Analytical Expression for Transient Heat Transfer in Concrete Core Activation (SE-14-018)

Maarten G. Sourbron, Dr.Eng., KU Leuven (University of Leuven), campus De Nayer, Sint-Katelijne-Waver, Belgium

4. An Absorption Chiller System Using Lithium Bromide and Water as Working Fluids: Exergy Analysis (SE-14-019)

S. Anand, Ph.D.¹, A. Gupta¹, S.K. Tyagi, Ph.D.² and Y. Anand¹, (1)Shri Mata Vaishno Devi University, Katra, India, (2)Sardar Swarn Singh National Institute of Renewable Energy (SSS-NIRE), Kapurthala, India

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 6 (INTERMEDIATE)

Building Control System Knowledgebase Generation, Building Cooling Heating and Power Component Evaluation, Climate Interaction on HVAC Design and Whole-Building Dilution Ventilation System Analysis

Track: Research Summit

Room: 612

Chair: Armin Rudd, Member, ABT Systems LLC, Annville, PA

This session begins with the exploration of building control system knowledgebase using the self-configuration method. This second session presents a new method for predicting building combined cooling heating and power application potential in each state and regions. The next presentation highlights research showing that sound climate data is a critical component of HVAC design, system sizing and energy consumption estimates. This final two presentations present a study focused on the in-situ impacts of various whole-building dilution ventilation systems.

1. Self-Configuration of Building Control System Using Knowledgebase (SE-14-C024)

Yan Chen, Student Member and Stephen Treado, Ph.D., P.E., Member, The Pennsylvania State University, University Park, PA

2. Principal Component Analysis for BHP Application Potential (SE-14-C025)

Bo Lin, Student Member¹, Chen Zhao, Ph.D.² and James Freihaut, Ph.D.³, (1)The Pennsylvania State University, State College, PA, (2)Princeton University, NJ, (3)The Pennsylvania State University, University Park, PA

3. Impacts of Climate Variability on Energy at a NASA Space Center (SE-14-C026)

Lee DeBaillie, P.E., Member, Scott Schuetter, P.E., Member and Doug Ahl, Ph.D., Energy Center of Wisconsin, Madison, WI

4. Multizone Air Change and Airflow in Two Houses Under Operation of Different Whole-Building Ventilation Systems (SE-14-C027)

Armin Rudd, Member, ABT Systems LLC, Annville, PA

5. Multizone Particulate and VOC Measurements in Two Lab Houses Under Operation of Different Whole-Building Ventilation Systems (SE-14-C028)

Armin Rudd, Member, ABT Systems LLC, Annville, PA

8:00 AM-9:30 AM

SEMINAR 13 (INTERMEDIATE)

Documentation and Contract Administration in Tendered and Design/Build Ground Coupled Heat Pump Projects

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B



Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Ed Lohrenz, Associate Member, GEOOptimize Inc, Winnipeg, MB, Canada

Construction documentation and contract administration for tendered projects need to be clear and concise to ensure the design intent of a ground coupled heat pump (GCHP) system is met. This is also true of design/build GCHP projects, but there is more leeway to work with clients and contractors to meet the design intent as cost-effectively as possible. This seminar considers the documentation and contract administration requirements of a tendered project and how that can differ from a design/build project.

1. Construction Docs for Closed-Loop Ground Heat Exchangers: System Installation, Meet Design Intent

Ryan Carda, P.E., Geoconnections Inc, Elkton, SD

2. Closed Loop Ground Heat Exchanger (GHX) Contract Administration

Terry Proffer, Major Geothermal, Wheatridge, CO

3. Design-Bid Documentation Requirements for Specifications and Drawings of GCHP Systems

Warren (Trey) Austin III, P.E., Member, Geo-Energy Services, Littleton, CO

8:00 AM-9:30 AM

SEMINAR 14 (INTERMEDIATE)

Indoor Air Quality in Retail Stores: Research and Applications



Track: Indoor Environment – Health, Comfort and Productivity

Room: 603

Sponsor: Environmental Health Committee, 04.03 Ventilation Requirements and Infiltration

Chair: David Grimsrud, Ph.D., Fellow Life Member, University of Minnesota, Minneapolis, MN

This session presents the results of recent contaminant and ventilation rate research in several types of retail stores. Prior to this new research, most air quality research was conducted in homes, offices and special research chambers. Common themes among the papers in this session are that most spaces meet the rates in ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality, yet some contaminant levels are relatively high, in particular where cooking takes place.

1. Indoor Air Quality in Retail Stores: Implications for Ventilation Exposure, and Energy Use (RP-1596)

Jeffrey Siegel, Ph.D., University of Toronto, Toronto, ON, Canada

2. Characterization of Air Exchange Rates and Associated Occupant Survey Outcomes in Retail Stores (RP-1596)

Yang-Seon Kim, Student Member, The Pennsylvania State University, University Park, PA

3. Contaminant Levels and Source Strengths in California Retail Stores

Wanyu R. Chan, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

8:00 AM-9:30 AM

SEMINAR 15 (INTERMEDIATE)

Occupant Behavior in Buildings

Track: Indoor Environment – Health, Comfort and Productivity

Room: 611

Sponsor: 04.07 Energy Calculations, 02.01 Physiology and Human Environment



Chair: Tianzhen Hong, Ph.D., P.E., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

Technologies alone do not guarantee low energy buildings. Occupant behavior plays an essential role in the design and operation of buildings, but it is quite often oversimplified. Occupant behavior refers to an occupant's movement and responses to discomfort, when his/her comfort needs are not met. Occupant behavior varies with time, space and individual, and is influenced by social context. It is random, complex and multidisciplinary. Having a better understanding and modeling of occupant behavior in buildings can improve the accuracy of building simulations and guide the design and operation of buildings. This seminar highlights related behavior research at various institutes.

1. The New International Energy Agency (IEA) Energy in Buildings and Communities (EBC) Programme Annex 66 on Occupant Behavior

Da Yan, Tsinghua University, Beijing, China

2. Agent-based Modeling of Occupant Behavior

Clinton J. Andrews, Ph.D., P.E., Member, Rutgers, The State University of New Jersey, New Brunswick, NJ

3. Overview of Occupant Behavior Research at the Technical University of Denmark

Bjarne W. Olesen, Ph.D., Technical University of Denmark, Kgs. Lyngby, Denmark

4. A Technical Framework to Describe Occupant Behavior in Buildings

Tianzhen Hong, Ph.D., P.E., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

8:00 AM-9:30 AM

SEMINAR 16 (INTERMEDIATE)

Using ASHRAE Standard 105-2014 for Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emissions

Track: Standards, Guidelines and Codes

Room: 609

Sponsor: 07.06 Building Energy Performance, 02.08 Building Environmental Impacts and Sustainability

Chair: Mark Heizer, P.E., Oregon Department of Consumer and Business Services, Salem, OR

ASHRAE Standard 105-2014, Standard Methods of Determining, Expressing, and Comparing Building Energy Performance and Greenhouse Gas Emission, provides a common basis for reporting and expressing building energy performance; comparing design options; and comparing energy performance in terms of energy resources used and greenhouse gas emissions created both across buildings and for energy efficiency measures within buildings. This seminar provides an overview and discusses new provisions related to primary energy performance and greenhouse gas emissions.

1. Standard 105 Overview and New Provisions

Adam W. Hinge, P.E., Member, Sustainable Energy Partnerships, Tarrytown, NY

2. Options for Determining Primary Energy Performance

Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

3. Evaluating Greenhouse Gas Emissions Using Standard 105

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

8:00 AM-9:30 AM

WORKSHOP 6 (BASIC)

Debate: The HVAC Procurement Process Contravenes the ASHRAE Code of Ethics

Track: Professional Skills

Room: 608

Sponsor: College of Fellows, 01.07 Business, Management & General Legal Education

Chair: Victor Goldschmidt, Fellow ASHRAE, Consultant, Northport, MI

College of Fellows series of debates. The complex procurement method for buildings holds conflicts among the technical, program and commercial objectives of designers, contractors, manufacturers, owners and tenants. These dynamic conflicts often result in processes which are expedient rather than professionally correct. The resulting buildings often fail to meet owners expectations. Is this expectation of failure normal? Is it the way things have to be? Is the ASHRAE Code of Ethics relevant and honored more in the breach than in fact?

1. Speaker

Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA; Don Beaty, P.E., Fellow ASHRAE, DLB Associates, Eatontown, NJ; Richard Rooley, FEng, Presidential Fellow Life Member, Rooley Consultants, Bucks, United Kingdom

2. Speaker

E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA; Ross Montgomery, P.E., Fellow ASHRAE, Quality Systems and Technology Inc., Parish, FL; Bill Coad, P.E., Presidential Fellow Life Member, Coad Engineering Enterprises, St Louis, MO

9:45 AM-10:45 AM

SPECIAL SESSION 1 (BASIC)

Are We Putting Enough Energy into Making Buildings Healthy?

Track: Indoor Environment – Health, Comfort and Productivity

Room: 606

Chair: Thomas H. Kuehn, Ph.D., Fellow ASHRAE, University of Minnesota, Minneapolis, MN

Keynote presentation for the Indoor Environment Track by ASHRAE President Bill Bahnfleth.

1. Are We Putting Enough Energy into Making Buildings Healthy?

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

9:45 AM-10:45 AM

SPECIAL SESSION 2 (BASIC)

Geothermal Heat Pump Track Keynote Presentation

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B

Chair: Gary Phetteplace, Ph.D., P.E., Member, GWA Research LLC, Lyme, NH

The Keynote Address kicks off the Ground Source Heat Pumps (GSHP) State of the Art: Design, Performance and Research track. While this session focuses on market conditions for GSHP, sessions that follow range from the basics of site selection and system design to operational experience and topics of current research in the field.

1. The Geothermal Heat Pump Industry: Market Barriers and Market Drivers

Douglas Dougherty, Geothermal Exchange Organization, Washington, DC

9:45 AM-10:45 AM

SPECIAL SESSION 3 (BASIC)

Research Summit Keynote Address

Track: Research Summit

Room: 609

Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX

Featured presentation for the Research Summit Track

1. Big Data, Bigger Challenges and Greater Opportunities

Krishnan Gowri, Ph.D., Member, Pacific Northwest National Laboratory, Seattle, WA

11:00 AM-12:00 PM

TECHNICAL PAPER SESSION 6 (INTERMEDIATE)

New Energy Efficient Technologies for Hydronic Heating and Cooling Systems

Track: Research Summit

Room: 611

Sponsor: 06.01 Hydronic and Steam Equipment and Systems

Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX

Escalating electrical costs and increased pressures to reduce consumption are driving research to provide new technologies for HVAC systems. These studies show new approaches to increase energy efficiency for hydronic heating and cooling systems.

1. Deluge Evaporative Cooling Performance of Wavy Fin and Tube Inclined Heat Exchangers (SE-14-020)

Yunho Hwang, Ph.D., Member and Sahil Popli, Student Member, University of Maryland, College Park, MD

2. Condensing Boiler and Vapor Vacuum Heating System Combo (SE-14-021)

Igor Zhadanovsky, Ph.D., Applied Engineering Consulting, Newton, MA

3. Cost Efficiency Comparison for the Hot Water Condensing Boiler and Vapor Vacuum Heating and Condensing Boiler Combo (SE-14-022)

Igor Zhadanovsky, Ph.D., Applied Engineering Consulting, Newton, MA



11:00 AM-12:00 PM

SEMINAR 17 (BASIC)

Ground Source Heat Pumps: Historical Perspective and Track Overview

Track: *Ground Source Heat Pumps: State of the Art Design, Performance and Research*

Room: Ballroom 6B

Sponsor: **06.08 Geothermal Heat Pumps and Energy Recovery Applications**

Chair: *Gary Phetteplace, Ph.D., P.E., Member, GWA Research LLC, Lyme, NH*

This session has two overall objectives and a separate speaker addressing each. The first speaker addresses the history of ground source heat pumps (GSHP), providing an overview of the many ways the technology has been applied as well as attempts to apply, including those that failed or were eclipsed by others. The second speaker provides an overview of the contents of the many sessions within the Ground Source Heat Pumps State of the Art: Design, Performance and Research track.

1. History of Geothermal Heating and Cooling Systems

Steve Smith, Enertech Global, LLC, Greenville, IL

2. Overview of the Geothermal Track at This Meeting

Gary Phetteplace, Ph.D., P.E., Member, GWA Research LLC, Lyme, NH



11:00 AM-12:00 PM

SEMINAR 18 (INTERMEDIATE)

New U.S. Environmental Protection Agency Guidance for Moisture and Humidity Control in Buildings

Track: *Indoor Environment – Health, Comfort and Productivity*

Room: 603

Sponsor: **01.12 Moisture Management in Buildings**

Chair: *Ray Patenaude, P.E., Member, The Holmes Engineering Group, Tierra Verde, FL*

Persistent and excessive dampness from rainwater and plumbing leaks and from shortcomings in HVAC design can create severe indoor air quality problems and sometimes health risks for building owners and occupants. To reduce such risks, the U.S. EPA has published guidance for architects, engineers and building operators with respect to managing moisture and humidity. These presentations provide practical, actionable suggestions for each of the professional disciplines. The information also is useful to building occupants or homeowners who have had the unfortunate experience of living or working in a building that has a dampness or high humidity problem.

1. The New EPA Guidance for Moisture Control: Its Background, Process and Purpose

Laura Kolb, US Environmental Protection Agency, Washington, DC

2. Top 10 Tips and Traps from New EPA Guidance for Managing Moisture in Building Design, Construction and Operation

Terry Brennan, Camroden Associate, Westmoreland, NY

3. Top 10 Tips and Traps From New EPA Guidance for Managing Moisture and Humidity in HVAC System Design, Installation and Operation

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



11:00 AM-12:00 PM

SEMINAR 19 (INTERMEDIATE)

Optimizing Operating Staff Capabilities and Energy Efficiency with Commissioning

Track: *Installation, Commissioning, Operation, Maintenance of Existing Buildings*

Room: 606

Sponsor: **07.09 Building Commissioning**

Chair: *Mike Eardley, P.E., Member, Cannon Design, Boston, MA*

A comprehensive commissioning process provides a facility's staff with information necessary to efficiently operate building systems. A formal monitoring based commissioning (MBCx) effort is also useful in investigating operational issues, troubleshooting, determining actions required to permanently correct the problem, reducing the frequency of issue reoccurrence and



improving equipment maintenance due to wear and tear on equipment. This session provides a case study where the commissioning process optimized the efficient facility that was delivered, and reviews the benefits of MBCx in achieving peak building system performance throughout a facility's lifetime.

1. Using Monitoring Based Commissioning to Improve the Capabilities of O&M Staff

H. Jay Enck, Member, Commissioning & Green Build Solutions Inc., Buford, GA

2. Chiller Plant Optimization through Proper Commissioning

Norman Nelson, P.E., Member, CH2M Hill, Portland, OR

11:00 AM-12:00 PM

SEMINAR 20 (INTERMEDIATE)

Pressure Independent Control Valves and Balance

Track: *HVAC&R Systems & Equipment*

Room: 607

Sponsor: **07.07 Testing and Balancing**

Chair: *Gaylon Richardson, Fellow ASHRAE, Engineered Air Balance, Houston, TX*

Pressure independent control valves (PICV) exist in the "in between world" of flow control valves. In some forms, they are considered as replacements to balancing devices. In other forms, they do not perform as balance devices are supposed to perform. This seminar addresses PICV valves and balance and proper applications of this type of control and achieving balance.

1. The PICV: A Discussion on the History, Theory and Application

James Hoxtor, Member, Danfoss Heating, Baltimore, MD

2. Field Testing Pressure Independent Control Valves; The Balancer's Perspective

Justin Garner, Member, Engineered Air Balance, Houston, TX

3. PICV Valves and Balancing; System Level Discussion of Valve Application and Alternatives to PICV Application

Mark C Hegberg, Member, Mechanical Equipment Inc, Chicago, IL



11:00 AM-12:00 PM

FORUM 1 (INTERMEDIATE)

Building Energy Policies Around the World

Track: *Standards, Guidelines and Codes*

Room: 609

Sponsor: **AASA, 02.08 Building Environmental Impacts and Sustainability**

Chair: *Ashish Rakheja, P.E., Member, AECOM, New Delhi, India; Thomas E. Watson, P.E., Presidential Fellow Life Member, Daikin Applied, Staunton, VA*

Energy use in buildings is responsible for more than 30% of global carbon dioxide emissions and has a significant role in climate change mitigation, given the large potential savings in both new and existing buildings. For new buildings, energy policies are a central element in achieving these potential savings. Such policies need to be dynamic and ambitious as well as supported by a policy package with long-term targets of achieving zero or positive energy for all new construction. This forum discusses dynamic and ambitious building energy policies around the world. ASHRAE Associate Society Alliance members from different countries are invited to discuss on energy efficiency policies. The goal of this forum is to identify the best practices in the codes and policy packages. The discussion also includes holistic approach, dynamic approach, good enforcement, individual elements of performance and overall performance of energy efficiency policies around the world.

11:00 AM-12:00 PM

WORKSHOP 7 (INTERMEDIATE)

Ethics of Design, Bidding and Construction

Track: *Professional Skills*

Room: 612

Sponsor: **01.07 Business, Management & General Legal Education**

Chair: *Norm Maxwell, P.E., Member, Environmental Air Quality, Great Neck, NY*



Often the need to maximize a business entity's operations (whether the business is a consulting engineering firm, a building owner/operator, a manufacturer or contractor) can create conflicts with the design, specification,

submittal, bidding and/or construction process. What firms sometimes believe they must do to compete from a business standpoint can be at variance with ethical practices of what they should do. This workshop presents ethical considerations relating to these issues from the varying viewpoints of ASHRAE members. Following the presentations, audience participation to examine these issues in real-world situations and how they have been dealt with is facilitated.

1. Ethics in Writing Specifications and Reviewing Submittals

Norm Maxwell, P.E., Life Member, Environmental Air Quality, Great Neck, NY

2. Codes of Ethics for HVAC Contractors and Design Build Professionals

Michael McLaughlin, P.E., Associate Member, Southland Industries, Dulles, VA

11:00 AM–12:00 PM

WORKSHOP 8 (INTERMEDIATE)

Variable Air Volume Reheat vs. Active Chilled Beams and Dedicated Outdoor Air Systems Workshop

Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 06.01 Hydronic and Steam Equipment and Systems, 06.05 Radiant Heating and Cooling

Chair: Mike McDermott, Member, Grumman Butkus Associates, Evanston, IL

Several recent articles claim that dedicated outdoor air systems plus active chilled beam systems are superior to variable air volume reheat systems on energy efficiency, first cost and air quality. Other articles paint a different picture and have found that a well-designed VAV system with reheat (including dual maximum zone controls, supply air temperature reset, duct static pressure reset and carbon dioxide controls in high intensity spaces) is hard to beat. This workshop explores both HVAC systems as they relate to first cost, thermal comfort, indoor air quality, energy use, floor to floor height, maintenance and flexibility.

1. Comparing Performance – Active Chilled Beam + DOAS or VAV Reheat

Steve Taylor, P.E., Fellow ASHRAE¹ and Peter Simmonds, Ph.D., Fellow ASHRAE², (1)Taylor Engineering, Alameda, CA, (2)Stantec, Sherman Oaks, CA

2. To Beam or Not to Beam?

Peter Simmonds, Ph.D., Fellow ASHRAE, Stantec, Sherman Oaks, CA

2:15 PM–3:45 PM

SEMINAR 21 (BASIC)

“I Know That I Should be Doing Building Information Modeling, but ...”: How BIM Is Practically Being Introduced and Used By People like You to Move Their Projects and Businesses Forward Toward a Connected and Collaborative BIM World

Track: HVAC&R Fundamentals and Applications

Room: 603

Sponsor: 01.05 Computer Applications, MTG.BIM Building Information Modeling

Chair: Tim Dwyer, Fellow ASHRAE, Bartlett School of Graduate Studies, University College London, London, United Kingdom

This seminar includes presentations from a range of practicing engineering consultants showing how they have taken hold of the BIM way of working, explaining the challenges and the current (and potential) benefits to their business, profession, end user and environment.

1. Are You Ready to Take the BIM Plunge? the Top 10 Things You Need to Know

Raj Setty, P.Eng., Member, Setty and Associates, Washington, DC

2. Taking the First Step Toward Realizing the Value of the “Information” in BIM: Moving Beyond 3D Drafting

Dennis Knight, P.E., Member, Whole Building Systems, LLC, Charleston, SC

3. What Keeps Some Consultants Away from BIM? Should It?

David Branson, P.E., Member, Compliance Services Group, Lubbock, TX

4:00 PM–5:30 PM

SEMINAR 22 (BASIC)

Building Information Modeling in Action: Beyond Computer Aided Design

Track: Professional Skills

Room: 603

Sponsor: 07.01 Integrated Building Design, BIM-MTG, 01.05 Computer Applications

Chair: Krishnan Gowri, Ph.D., Member, Pacific Northwest National Laboratory, Seattle, WA



BIM has gained wide acceptance by the building industry as a productivity enhancement vehicle by creating a single electronic repository of building data. This BIM model can be used from the earliest design stages of architectural modeling to commissioning and construction completion. In several instances, the BIM model is seen as a living digital representation of the building that is updated and maintained throughout the life of the building. Recently, BIM models are used to perform energy modeling, construction clash detection and quantity estimating beyond the traditional CAD and rendering. This session features BIM industry experts who have implemented BIM requirements in real-life projects, providing tips and tricks in working with BIM models.

1. BIM for Constructibility and Clash Detection

Michael Smith, P.Eng., Intergraph Corporation, Houston, TX

2. The Evolution of BIM from Design to Construction: Case Studies

Raj Setty, P.Eng., Member, Setty and Associates, Washington, DC

3. BIM Workflow for Energy Modeling

Chien Si Harriman, Carmel Software Corporation, San Rafael, CA

Tuesday, July 1

8:00 AM–9:30 AM

CONFERENCE PAPER SESSION 7 (INTERMEDIATE)

Monitoring of Ground Source Heat Pump Systems

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: 609

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Jeffrey Spitler, Ph.D., P.E., Oklahoma State University, Stillwater, OK

Careful monitoring of ground source heat pump systems can provide a wealth of information – providing guidance for future designs as well as allowing performance of the monitored system to be optimized. Presentations in this session describe monitoring of four real world systems.

1. Eight Years of Operation of 615 Ton Geothermal Nursing Home in Northern Tier (SE-14-C029)

Carl D. Orio, Member, Water Energy Distributors, Inc., Hampstead, NH

2. Real-World Geothermal – Measured Performance and New Approaches (SE-14-C030)

Stephen A. Hamstra, P.E., Member, Greensleeves LLC, Zeeland, MI

3. Case Study of a Central GSHP System in a Warehouse (SE-14-C031)

Xiaobing Liu, Ph.D., Member and Mini Malhotra, Oak Ridge National Laboratory, Oak Ridge, TN

4. Importance of Monitoring Ground Coupled Heat Pump System Operation (SE-14-C032)

Ed Lohrenz, Member, Geo-Xergy Systems, Inc., Winnipeg, MB, Canada

8:00 AM–9:30 AM

CONFERENCE PAPER SESSION 8 (INTERMEDIATE)

Energy Use and Technologies of High Performance Buildings

Track: Research Summit

Room: 607

Sponsor: 04.10 Indoor Environmental Modeling, 05.03 Room Air Distribution

Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX



It is evident that none of the influencing factors alone, including region, climate, technologies and building size, is determinant of the energy use intensity (EUI). Achieving high energy performance calls for a holistic approach of integrated design and operation by considering climate, technology, operation and maintenance as well as human behavior.

1. Revisit of Energy Use and Technologies of High Performance Buildings (SE-14-C033)

Cheng Li, Ph.D. and Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Energy Performance of Major Types of Building Envelope in the Hot Summer and Cold Winter Zone of China (SE-14-C034)

Yun Zheng, Guoqing He, Ph.D. and Sanming Zhang, Zhejiang University, Hangzhou, China

3. Performance Based Building System Evaluation for U.S. Department of Energy Energy Asset Score (SE-14-C035)

Supriya Goel, Nora Wang, Michael Rosenberg and Vrushali Mendon, Member, Pacific Northwest National Laboratory, Richland, WA

4. Advanced Lighting Controls: A New Frontier in Building Management Systems (SE-14-C036)

Edwin Poland, DNV KEMA, Wheaton, IL

8:00 AM-9:30 AM

SEMINAR 23 (INTERMEDIATE)

Chiller Efficiency and Standard 90.1: Where Do We Go From Here?

Track: Standards, Guidelines and Codes

Room: Ballroom 6B

Sponsor: 08.02 Centrifugal Machines

Chair: Susanna Hanson, Member, Trane, LaCrosse, WI

ASHRAE/IES Standard 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings, raised chiller efficiency for most equipment types and sizes. The standard is now believed to be approaching technological or cost-justification limits. This seminar explains the changes in the 2013 standard and identifies the constraints of present technology, including the impact of past and future refrigerant transitions. Where are the remaining opportunities for advancing chiller efficiency, in a cost-justified standard? Regional requirements, system efficiency, operational requirements, enforcement and certification and in situ monitoring are discussed. Suggestions from the audience are welcome.

1. 90.1 Chiller Efficiency: Today and Future

Richard Lord, Member, Carrier Corp., Murfreesboro, TN

2. 90.1, Chiller Efficiency and the Real World

Paul Kozlov, Smardt, Victoria, Australia

8:00 AM-9:30 AM

SEMINAR 24 (ADVANCED)

Energy Efficiency in Commercial Foodservice: Experiences with LEED and Energy Modeling

Track: Professional Skills

Room: 612

Sponsor: 05.10 Kitchen Ventilation

Chair: Don Fisher, P.Eng., Associate Member, PG&E Food Service Technology Center, San Ramon, CA

A motivating force for sustainability in the restaurant business is energy and water savings. The foodservice industry has embraced the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating program with tempered enthusiasm. But designing a LEED restaurant or commercial kitchen is not without its challenges. Up to 75% of the energy consumed in a foodservice facility is driven by the process loads. A modeler needs a comprehensive understanding of the process loads to derive accurate predictions for energy use in a restaurant. This seminar shares real-world experiences with foodservice LEED projects and energy modeling.

1. Estimating Food Process Loads: Loaded with Uncertainty

Vernon A Smith, P.E., Associate Member, Smith Energy Engineers, Niwot, CO

2. Experiences in Designing and Constructing a LEED Cafeteria on the NREL Campus

Rois M. Langner, National Renewable Energy Laboratory, Golden, CO

3. Practical Approaches to Developing & Using Energy Models for LEED Restaurants

Adam P. Jarboe, Member, YUM! Global Engineering, Louisville, KY

8:00 AM-9:30 AM

SEMINAR 25 (ADVANCED)

International Energy Agency Energy in Buildings and Communities Annex 59: High Temperature Cooling and Low Temperature Heating In Buildings

Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 06.03 Central Forced Air Heating and Cooling Systems, 06.05 Radiant Heating and Cooling

Chair: Bjarne Olesen, Technical University of Denmark, Copenhagen, Denmark

It is important to minimize temperature differences in HVAC systems since high differences result in reduced efficiencies and therefore increased energy use. Starting from a new perspective, Annex 59 is working to develop a novel way for analyzing HVAC systems in buildings by reducing mixture loss and transfer loss then applying it in high temperature cooling and low temperature heating system. The seminar introduces the current progress of Annex 59.

1. Introduction of IEA ECB Annex 59

Yi Jiang, Tsinghua University, Beijing, China

2. Cooling Load Extraction: Radiant vs Air System

Stefano Corgnani, Politecnico di Torino, Torino, Italy

3. Energy Monitoring of Thermally Activated Building Systems Coupled to Geothermal Heat Pumps

Vincent Lemort and Francois Randaxhe, University of Liège, Liège, Belgium

8:00 AM-9:30 AM

SEMINAR 26 (INTERMEDIATE)

Indoor Air Quality and Comfort: Ventilation and Air-Conditioning

Track: Indoor Environment – Health, Comfort and Productivity

Room: 603

Sponsor: 05.03 Room Air Distribution, Publishing and Education Council

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

This session offers a select group of recently published papers from the ASHRAE HVAC&R Research Journal regarding new developments in ventilation and air-conditioning technology to include research of displacement ventilation with a radiant floor heating/cooling system and human response to convective and radiant cooling.

1. Human Response to Local Convective and Radiant Cooling in a Warm Environment

Arsen K. Melikov, Ph.D., Fellow ASHRAE, Technical University of Denmark, Lyngby, Denmark

2. Experimental Study including Subjective Evaluations of Mixing and Displacement Ventilation combined with Radiant Floor Heating/Cooling System

Angela Simone, Ph.D., Member, Denmark Technical University, Kgs. Lyngby, CA, Denmark

3. Stratum Ventilation: A Solution to Elevated Room Temperature

John Zhang Lin, Ph.D., City University of Hong Kong, Hong Kong, Hong Kong

8:00 AM-9:30 AM

SEMINAR 27 (INTERMEDIATE)

Airborne Particle and Bacteria Control Technologies and Flow Demand Control for Energy Conservation in Critical and Controlled Environments

Track: Indoor Environment –

Health, Comfort and Productivity

Room: 611

Sponsor: 09.11 Clean Spaces, 09.06 Healthcare Facilities

Chair: Peter B. Gardner, P.E., Member, Torcon, Inc., Red Bank, NJ

Reduction of airborne particle and microbial contaminations has been one of the main focuses in design and operation of critical and controlled environments such as cleanrooms, labs, operating rooms and isolation rooms. These environments typically consume much higher energy than office spaces. The speakers present recent developments and innovative practices: particle generation and dispersion by human coughing; its indoor migration paths; investigation of an HVAC system's effectiveness in particle removal; how to use continuous particle or microbial sensing to ensure the real-time indoor air quality and cleanliness; and how to achieve required air cleanliness automatically in healthcare operating rooms and industrial cleanrooms with decreased energy consumption by cutting down unnecessary airflow oversupply during unoccupied periods.

1. The Effects of Patient Movement on Particles Dispersed By Coughing in a Calm Indoor Environment

Yanzheng (Don) Guan, Ph.D., P.E., Member, Alamelu Ramesh, P.E., Member and Farhad Memarzadeh, Ph.D., P.E., Member, National Institutes of Health, Bethesda, MD

2. Infection Control in Hospitals by Real-time Bacteria Control

Rupert Mack, P.E., Member, Weiss Klimatechnik GmbH, Reiskirchen-Lindenstruth, Germany

3. Clean Environment Energy Conservation by Flow Demand Control Based on Particle Sensing

Wei Sun, P.E., Member, Engysco Inc., Ann Arbor, MI

8:00 AM–9:30 AM

SEMINAR 28 (INTERMEDIATE)

Tools and Methods to Manage Laboratory and Research Facilities for Effective and Efficient Long-Term Operations

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606

Sponsor: 09.10 Laboratory Systems

Chair: Carol Donovan, Associate Member, Sebesta Blomberg & Associates, Woburn, MA

Research facilities and biosafety laboratories present a unique challenge to designers, owners and operators with their inherent complexity of systems, health and safety requirements, regulatory compliance, energy use intensity and environmental impacts. These mission critical facilities require continuous monitoring and commissioning and a team approach to communications between operators and users to ensure maximum system reliability and safe operations. The three papers presented in this seminar provide three perspectives to broaden understanding of how complex laboratory systems and operations can be combined with quality facility management and commissioning to achieve effective and efficient long-term operations.

1. Annual Biocontainment Performance Verification

Scott Rusk, Kansas State University, Manhattan, KS

2. Use of Specialized Commissioning Tests to Maximize Performance of Variable Air Volume Lab Ventilation Systems

Thomas Smith, Member, Exposure Control Technologies, Inc., Cary, NC

3. 12 Things You Need to Know about Monitoring-Based Commissioning

Craig Engelbrecht, Siemens Technologies, Buffalo Grove, IL

9:45 AM–10:45 AM

SEMINAR 29 (INTERMEDIATE)

Controls

Track: HVAC&R Systems & Equipment

Room: 607

Sponsor: 01.04 Control Theory and Application, Publishing and Education Council

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

This session offers a select group of recently published papers from the ASHRAE HVAC&R Research Journal regarding new developments in model predictive controls and virtual airflow meters.

1. Implementation of Model Predictive Control for an HVAC System in a Mid-Size Commercial Building

Russell Taylor, Ph.D., Member, United Technologies Research Center, East Hartford, CT

2. Investigations of a Virtual Airflow Meter using Projected Motor and Fan Efficiencies

Gang Wang, Ph.D., University of Miami, Coral Gables, FL

9:45 AM–10:45 AM

SEMINAR 30 (INTERMEDIATE)

Liquid Desiccant Dehumidification As a Way to Enhance IAQ and Dedicated Outdoor Air System Performance

Track: HVAC&R Systems & Equipment

Room: 603

Sponsor: 08.12 Desiccant Dehumidification Equipment and Components

Chair: Michael S. Sherber, P.E., Member, PPL SavageALERT, Inc., Rocky Hill, CT

This session describes how liquid desiccant systems can enhance indoor air quality and the performance of DOAS in building HVAC systems.

1. Improving Indoor Air Quality with Liquid Desiccant Air Conditioning

Philip C. Farese, Ph.D., Member, Advantix Systems, Sunrise, FL

2. First Results of Testing and Demonstration Program of a Membrane Liquid Desiccant DOAS System

Peter Vandermeulen, Associate Member¹ and Eric Kozubal, Member², (1)7AC Technologies, Inc., Woburn, MA, (2)National Renewable Energy Laboratory, Golden, CO

9:45 AM–10:45 AM

SEMINAR 31 (INTERMEDIATE)

Performance of Metal and Textile Air Dispersion Systems

Track: HVAC&R Systems & Equipment

Room: 611

Sponsor: 05.02 Duct Design

Chair: Stephen A. Idem, Ph.D., Tennessee Tech University, Cookeville, TN

This seminar compares traditional metal duct system performance with metal and textile air dispersion systems. Metal duct systems discharge air to specific zones, resulting in less efficient mixing of air in the occupied space. Air dispersion systems continuously convey discharge air within the space being conditioned, thus providing consistent and uniform air dispersion in the occupied space and resulting in reduced energy usage. Air dispersion systems are typically made of woven textile material, but they can also be constructed from sheet metal or plastic film. Porous and non-porous options are available. Advantages and limitations of air dispersion systems are discussed.

1. Textile Air Dispersion Systems

Kevin J. Gebke, Member, DuctSox Corporation, Peosta, IA

2. Metal Air Dispersion Systems - An Overview

Scott Hobbs, Member, McGill AirFlow LLC, Renton, WA

3. Design and Construction of Metal Air Dispersion Systems

Bob Reid, Member, Tangible Products, The Woodlands, TX

9:45 AM–10:45 AM

SEMINAR 32 (INTERMEDIATE)

Developing Airflow and Thermal Models for Data Centers: Comparing and Contrasting the Design and Operation

Use Cases

Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: Nick Gangemi, Member, Facility Gateway Corp, Penfield, NY

Enterprise data centers require significant cooling. Computational fluid dynamics (CFD) modeling can be used for a variety of tasks from conceptual design, through assessment, to operational deployment decisions to maximize the data hall availability, capacity and efficiency. With increasing use, a variety of tools and modeling strategies have been developed. What can be achieved, and how quickly depends on the modeling tool sophistication and the user's modeling decisions. This session looks at the two ends of the spectrum - concept and operation - to enable prospective users to understand approaches for different uses and the skills they need to be effective.

- 1. Airflow and Thermal Modeling for the Design of Data Centers**
James VanGilder, P.E., Member, Schneider Electric, Billerica, MA
- 2. Calibration: Developing a Useful Airflow and Thermal Model to Maximize DC Availability Capacity and Efficiency**
Mark Seymour, Member, Future Facilities, London, United Kingdom

9:45 AM-10:45 AM

SEMINAR 33 (INTERMEDIATE)

Impact of Emerging Technologies and Practices on International Organization for Standardization (ISO) Standards and Design Guides for Cleanrooms

Track: Standards, Guidelines and Codes
Room: 609



Sponsor: 09.11 Clean Spaces

Chair: Wei Sun, P.E., Member, Engsysco Inc., Ann Arbor, MI

The seminar covers multiple sectors of emerging technologies and practices in today's cleanrooms, and more importantly their current or future impacts on ISO standards, Institute of Environmental Sciences and Technology (IEST) and ASHRAE design guidelines. Presentations include illustration of a computational tool that can handle various process energy loads beyond the capacity of traditional building energy software; innovative approaches to reduce costs in cleanroom construction, energy consumption and maintenance; and new ASHRAE research findings of room pressure control technologies and airlock utilization and the newly released ASHRAE "Pressure Differential Table" for cleanrooms.

1. Computational Tool for Energy Consumption Prediction for Cleanroom Facilities and Applicability Study for Standards and Design Guides
Shih-Cheng Hu, Ph.D., Member, Cheng-Kang Chang and Yi-Eun Cheng, National Taipei University of Technology, Taipei, Taiwan

2. Good Practices of Contamination Control in Clean Manufacturing: Case Study and Beyond

Vinod P. (V. P.) Gupta, P.E., Member, 3M Company, Saint Paul, MN

3. Updated Cleanroom Design Guidelines from Recent ASHRAE Pressure Differential and Airlock Studies

Wei Sun, P.E., Member, Engsysco Inc., Ann Arbor, MI

9:45 AM-10:45 AM

SEMINAR 34 (INTERMEDIATE)

What The Well?

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research
Room: Ballroom 6B



Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Chris Gray, P.E., Member, Southern Company, Birmingham, AL

Believe it or not, for geothermal heat pump systems to be geothermal heat pumps, they must tie into the Earth...Yup, it's true! The series of ground source heat pump (GSHP) sessions continues with a focus on considerations for components outside the building. Design considerations for closed loop systems including material selection, sizing and applicable codes are covered. Following is a discussion of surface water heat pumps and a research update on surface water heat exchangers. Lastly a highly experienced driller shares common pitfalls made during well/loop design and offers suggestions to save time and money.

1. Closed Loop Ground Heat Exchangers from the Ground Up (or Down)

Kirk T. Mescher, P.E., Member, CM Engineering, Inc., Columbia, MO

2. Design Tools for Surface Water Heat Pump Systems

Jeffrey Spitzer, Ph.D., P.E., Oklahoma State University, Stillwater, OK

3. Geothermal Design Effects on Installation

Russell Buras, LoopTech International, New Waverly, TX

9:45 AM-10:45 AM

WORKSHOP 9 (INTERMEDIATE)

A Multi-Dimensional View of HVAC Maintenance

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606

Sponsor: 07.03 Operation and Maintenance Management

Chair: Robert G. Baker, Fellow ASHRAE, BBJ Consulting Service, Riverview, FL



ASHRAE/ACCA Standard 180, Inspection and Maintenance of Commercial Building HVAC Systems, first published in 2008, has achieved broad acceptance. In addition, it is referenced in both the Uniform Mechanical Codes from the International Association of Plumbing and Mechanical Officials and the International Mechanical Codes from the International Code Council. Groups in California have put considerable effort into building utility incentive programs around it designed to improve the level and quality of maintenance of rooftop units in that state. This seminar explores the success of the various applications of the standard from different vantage points, including the design engineer, service provider, building owner and regulatory authority.

1. The Contractor/Service Provider

Mike Gallagher, P.E., Member, Western Allied Corp., Santa Fe Springs, CA

2. The Building Owner/Engineer

Richard A. Danks, Member, NASA, Cleveland, OH

9:45 AM-10:45 AM

WORKSHOP 10 (INTERMEDIATE)

The Impact of Change Orders and the Damages That They Can Cause

Track: Professional Skills

Room: 612

Sponsor: 07.02 HVAC&R Contractors and Design Build Firms, 01.07 Business, Management & General Legal Education

Chair: Michael Connor, P.E., Member, Connor Engineering Solutions, Alpharetta, GA; Michael McLaughlin, P.E., Associate Member, Southland Industries, Dulles, VA

This interactive session features three real life change order examples given from three different contract perspectives; design/bid/build; design/build; and integrated project delivery. The audience is presented the scenarios and then divided into smaller groups to discuss the merits of the change order proposal and what if anything should be awarded to the contractor including monetary compensation and/or extensions of time. After the individual group discussions, audience comments are compared and contrasted to the actual result and reasoning behind the real outcome.

1. Destroying the Myth "Contractors Do Not Like Changes"

James Fields, Member, Superior Mechanical Services, Inc, Greensboro, NC

2. So Happy Together: Scope Change, Design Refinement, or Field Condition

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



11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 7 (INTERMEDIATE)

Air Distribution Analysis of Terminal Units and Variable Air Volume (VAV) System Control

Track: Research Summit

Room: 611

Sponsor: 05.03 Room Air Distribution

Chair: David E. Claridge, Ph.D., P.E., Fellow ASHRAE, Texas A & M University, College Station, TX



These papers are meshed together on two simple topics - VAV terminal units and diffusers. Two parts are based on the performance of VAV boxes and how they assist in energy reduction and personal comfort. Two others discuss the impact of the air pattern and distribution in the space. The session ends with a presentation that ties these together to utilize static pressure rest.

1. Numerical Study of a Ventilation System Based on Wall Confluent Jets (SE-14-023)

Setareh Janbakhsh, Linkoping University, Linkoping, Sweden

2. Preliminary Test and Analysis of A Stirling Engine Based Residential Tri-generation System at TRCA Archetype Sustainable House (SE-14-024)

Navid Ekrami, Ryerson University, Toronto, ON, Canada

3. Characterizing Airflow and Power of VAV Series Fan-Powered Terminal Units from Component Data: Part 1 (SE-14-025)

Peng Yin, Student Member, Texas A&M University, College Station, TX

4. Characterizing Airflow and Power of VAV Series Fan-Powered Terminal Units from Component Data: Part 2 (SE-14-026)

Peng Yin, Student Member, Texas A&M University, College Station, TX

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 9 (INTERMEDIATE)

Evaluating Building Performance for Real Cost Saving Options

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606

Sponsor: 07.06 Building Energy Performance, 07.09 Building Commissioning

Chair: Michelle Contri, P.E., Member, DLB Associates, Eatontown, NJ

This session provides building energy modeling ideas to reduce the difference between modeled energy consumption with meter energy consumption and how these models can be used to evaluate energy conservation methods during the measurement and verification process. This session will also address quantitative airtightness testing that is required in some energy codes and ways to maximize boiler efficiency at part load conditions.

1. Building Enclosure Airtightness Testing in Washington State: Lessons Learned about Air Barrier Systems and Large Building Testing Procedures (SE-14-C037)

Graham Finch, P.Eng., Associate Member, RDH Building Engineering Ltd., Vancouver, BC, Canada

2. Targeted Calibration of Energy Models for Existing Building (SE-14-C038)

Ery Djunaedy, Ph.D., Member and Kevin Van Den Wymelenberg, University of Idaho, Boise, ID

3. Use Calibrated Whole Building Energy Model to Disaggregate Retrofit Savings and Evaluate Demand- Response Strategies (SE-14-C039)

Ke Xu, Ph.D., Associate Member¹, James Freihaut, Ph.D.², Payam Delgoshaei, Ph.D.², Scott Wagner¹ and Mark Stutman, Member¹, (1)The Pennsylvania State University, Philadelphia, PA, (2)The Pennsylvania State University, University Park, PA

4. Case Study: Optimization of an Industrial Steam Boiler System Operation (SE-14-C040)

Bei Zhang, Ph.D., Student Member, Yunhua Li, Ph.D., Student Member and Mingsheng Liu, Ph.D., P.E., Member, Bes-Tech Inc., Omaha, NE

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 10 (INTERMEDIATE)

Methods to Predict and Verify Outstanding Indoor Environmental Quality

Track: Indoor Environment – Health, Comfort and Productivity
Room: 603

Chair: Thomas H. Kuehn, Ph.D., Fellow ASHRAE, University of Minnesota, Minneapolis, MN

Design of superior indoor environments requires attention to several factors including lighting, sound, air movement, contaminant transport and thermal comfort. The papers in this session describe models, laboratory tests and field measurements that advance the state-of-the-art in indoor environmental design. Applications include offices, laboratories, health care facilities and schools.

1. Annual Daylight Glare Evaluation for Typical Perimeter Offices: Simulation Models Vs. Full Scale Experiments Including Shading Controls (SE-14-C041)

Ying-Chieh Chan, Student Member, Jason Konstantzos, P.E., Student Member and Athanasios (Thanos) Tzempelikos, Ph.D., Member, Purdue University, West Lafayette, IN

2. Transport of Respiratory Aerosols in Patient Corridors Subject to Directional and Non-Directional Airflow- a Case Study (SE-14-C042)
Ehsan S. Mousavi-Rizi, Student Member and Kevin R. Grosskopf, Ph.D., Associate Member, University of Nebraska, Lincoln, NE

3. Determining Annoyance Thresholds of Tones in Noise (SE-14-C043)
Jennifer M. Francis, Joonhee Lee and Lily M. Wang, Ph.D., Member, University of Nebraska – Lincoln, Omaha, NE

4. Field Study on Effectiveness of Periodic Reversible Supply Exhaust Ventilation Strategy (SE-14-C044)

Essam E. Khalil, Ph.D., Fellow ASHRAE¹, Ahmed Fahim, Ph.D., P.E., Member², Ahmed Osama, P.E.¹ and Esmail ElBialy, Ph.D., P.E.¹, (1)Cairo University, Cairo, Egypt, (2)HBRC, Cairo, Egypt

5. Effect Of Wall Exhaust and Spill Locations On Indoor Air Quality In a Chemical Laboratory (SE-14-C045)

Essam E. Khalil, Ph.D., Fellow ASHRAE, Sami Morad, Dr.Ing. Mahmoud Fouad, Dr.Ing., Member and Ayman Shabaan, P.Eng., Cairo University, Cairo, Egypt

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 11 (INTERMEDIATE)

New Developments in Simulation and Modeling of Ground Heat Exchangers

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Jeffrey Spitler, Ph.D., P.E., Oklahoma State University, Stillwater, OK

Simulation and modeling of ground heat exchangers are commonly used for both design and energy calculations of ground source heat pump systems. This session covers new developments in simulation and modeling of ground heat exchangers and interpretation of thermal response tests used to estimate thermal conductivity for simulation and design of ground heat exchangers.

1. A New Hybrid Model for Bore Field Heat Exchangers Performance Evaluation (SE-14-C046)

Damien T. S. Picard, Ph.D., Catholic University of Leuven (KU Leuven), Leuven, Belgium

2. The Effect of Natural Convection on Thermal Response Test (SE-14-C047)

Wonjun Choi and Ryoza Ooka, Ph.D., Affiliate, University of Tokyo, Tokyo, Japan

3. Experimental Validation of a Numerical Model for the Thermal Response of a Borehole Field (SE-14-C048)

Patricia Monzó, P.Eng.¹, Félix Ruiz-Calvo, P.Eng.², José Acuña, Ph.D.¹ and Carla Montagud, Ph.D.², (1)Royal Institute of Technology, Stockholm, Sweden, (2) Universitat Politècnica de València, Valencia, Spain

4. An Alternative to Ashrae’s Design Length Equation for Sizing Borehole Heat Exchangers (SE-14-C049)

Mohammadamin Ahmadfard and Michel Bernier, Ph.D., Member, Ecole Polytechnique de Montreal, Montreal, QC, Canada

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 12 (INTERMEDIATE)

Fire and Smoke Safety Design for Large and Tall Buildings

Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 05.06 Control of Fire and Smoke

Chair: Paul Turnbull, Member, Siemens Building Technologies, Inc., Buffalo Grove, IL

Proper design of a smoke control system requires that specific fire scenarios including design fires need to be analyzed taking into account the characteristics of each project. Fire data on temporal combustion characteristics that define



design fires, such as heat release rates, temperatures, radiant heat flux, smoke and composition of fire gases for different fire scenarios are indispensable in carrying out fire safety engineering analysis and design of buildings. This session also presents a hand calculation method of analyzing high-rise smoke movement based on an analytical model and its solution to the coupled heat and mass transfer through shafts.

1. Design Fires for Large and Tall Buildings (SE-14-C050)

John H. Klote, Ph.D., P.E., Fellow ASHRAE, Fire and Smoke Consulting, Leesburg, VA

2. Results of Fire Experiments to Quantify Residential Design Fires (SE-14-C051)

Alex Bwalya, Ph.D., Ahmed Kashef, Ph.D., P.E., Member and Gary Lougheed, Ph.D., National Research Council Canada, Ottawa, ON, Canada, Ottawa, ON, Canada

3. A Hand Calculation Method of Smoke Movement through High-Rise Building Shaft (SE-14-C052)

Dahai (Darren) Qi, Student Member, Liangzhu (Leon) Wang, Ph.D., Member and Radu Zmeureanu, Ph.D., Member, Concordia University, Montreal, QC, Canada

11:00 AM-12:30 PM

SEMINAR 35 (INTERMEDIATE)

Advances in Low Global Warming Potential (GWP)

Refrigerants

Track: Refrigeration

Room: 612

Sponsor: 03.01 Refrigerants and Secondary Coolants, MTG – Lower GWP Alternative Refrigerants

Chair: Barbara Minor, Member, DuPont, Wilmington, DE

Significant progress is being made in the development and testing of low GWP alternatives to hydrofluorocarbon (HFC) and hydrochlorofluorocarbon (HCFCs) refrigerants. This seminar focuses on several applications of refrigerant development including air conditioning, high temperature heat pumps and refrigeration. Of particular concern is development of new refrigerants for air conditioning that perform well at high ambient temperatures such as in the Middle East. Some regions are just beginning their transition away from HCFC-22 and are looking for low GWP HCFC-22 alternatives with similar performance. Information is also presented on refrigerant/lubricant property development including miscibility, solubility and viscosity properties.

1. Considerations for the Development of Sustainable Refrigerants for Air Conditioning

Thomas J. Leck, Ph.D., Member, DuPont de Nemours and Company, Wilmington, DE

2. Refrigerant/Lubricant Properties of New Low GWP Options

Gregory Smith, Honeywell, Buffalo, NY

3. Zero-Ozone Depleting Potential (ODP), Low-GWP Working Fluids for High Temperature Heat Pumps

Konstantinos Kontomaris, Ph.D., Member, DuPont, Wilmington, DE

4. Sustainable Refrigerant Solutions for HVAC&R

Laurent Abbas, Ph.D., Associate Member, Arkema Inc, King of Prussia, PA

11:00 AM-12:30 PM

SEMINAR 36 (INTERMEDIATE)

Gain Market Recognition by Elevating Your Firm's Brand and Social Media for Business: Are YOU Taking Advantage of it?

Track: Professional Skills

Room: 607

Sponsor: Electronic Communications Committee

Chair: Karine Leblanc, Member, US Air Conditioning Distributors Engineering, City of Industry, CA

Gaining market recognition in today's technology-obsessed world is easy when you position yourself as a technical expert by writing white papers, trade publication feature articles or even posting your ideas/thoughts on social media sites. With 1 billion Facebook users, 645 million active Twitter users and 370 more apps, it's no wonder that businesses are moving forward with the social media era - ASHRAE being one of them. This session proves WHY you need

to be published and WHAT it takes to make it happen; discussing websites, content, design, social media, blogs, do's and don'ts and more.

1. The Who, What, Where, When and Why of Getting Published

Mindi L. Zissman, Zissman Media, Chicago, IL

2. What Works and What Doesn't Work

Mary Moore, Member, Syska Hennessy Group, Fairfax, VA

3. Repurposing it All

Tony Kempa, Environmental Systems Design, Chicago, IL

4. Social Media for Business: Are You Taking Advantage Of It?

Karine Leblanc, Member, US Air Conditioning Distributors Engineering, City of Industry, CA

11:00 AM-12:30 PM

SEMINAR 37 (INTERMEDIATE)

Measuring Commercial HVAC Performance through Load-Based Testing

Track: Standards, Guidelines and Codes

Room: 609

Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps, co: 8.7, 07.06 Building Energy Performance

Chair: Mira Vowles, Member, Bonneville Power Administration, Portland, OR

Load-based testing is intended to better represent the energy consumption of HVAC equipment in real-world conditions, especially variable capacity and climate-specific systems and accessories. Rather than testing at a fixed entering condition, load-based testing targets various loads and ambient conditions, to develop a performance map for the system. Load-based testing is intended to capture the impact of accessories, like economizers, variable speed components, staging, evaporative strategies and control algorithms. This seminar covers the need for unitary commercial equipment load-based testing and several approaches to develop system performance maps.

1. The Shortcomings of Traditional Single-Number Efficiency Metrics, and the Potential Value of a Load-Based Rating Method

Dan Berman, Member, Western Cooling Efficiency Center, Davis, CA

2. Research to Develop and Use a Load-Based Method of Test

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

3. Load-Based Testing of Variable Refrigerant Flow Systems

Ron Domitrovic, Ph.D., Member, EPRI, Knoxville, TN

4. Laboratory and Field Performance Testing of Climate-Appropriate Commercial Air Conditioners

Jonathan Woolley, Member, University of California, Davis, CA

1:30 PM-3:00 PM

SEMINAR 38 (INTERMEDIATE)

Operating and Maintaining Oil-Free Centrifugal Chillers

Track: Installation, Commissioning, Operation,

Maintenance of Existing Buildings

Room: 603

Sponsor: 08.02 Centrifugal Machines

Chair: Phillip Johnson, P.E., Member, Daikin Applied, Staunton, VA

Oil-free centrifugal chillers have been on the market for more than a decade. Some chilled water plants have these chillers installed alongside other conventional oil-lubricated centrifugal chillers, while other installations use only oil-free centrifugal chillers. During that time, manufacturers, owners and operators have accumulated experience regarding maintenance practices, performance trend logs, service records and reliability. This session shares lessons learned and best practices by comparing and contrasting operating and maintenance issues of conventional and oil-free centrifugal chillers.

1. Comparative Application and Maintenance Aspects of Oil-Free Chillers

Paul Kozlov, Smardt, Victoria, Australia

2. State of the Industry in Oil-Free Compressors: What's Oil Really Got To Do With It?

W. Ryan Geister, Member, Trane, La Crosse, WI

3. Operating & Maintaining Oil-Free Centrifugal Chillers

Gabriel Peters, Bullock, Logan & Associates, Inc., Elk Grove Village, IL



3:15 PM-4:45 PM
SEMINAR 39 (ADVANCED)

The Road to Success with the New Refrigeration Commissioning Guide

Track: Refrigeration



Room: 603

Sponsor: Refrigeration Committee, TC10.7, TC3.01, TC2.8, 08.01
Positive Displacement Compressors

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

Refrigeration systems account for a significant portion of commercial building energy use and are often the largest energy end use in food and beverage facilities. Thousands of refrigeration systems are installed every year in facilities ranging from convenience stores to large, sophisticated frozen food distribution centers. Properly commissioned systems reduce energy costs, are easier to maintain, help minimize liabilities from refrigeration leaks and reduce loss of product. This seminar introduces the recently published Refrigeration Commissioning Guide for Commercial and Industrial Systems and illustrates the benefits of its proper application with examples from commercial refrigeration.

1. Development of the New Refrigeration Commissioning Guide

Richard R. Royal, P.E., Member, Walmart, Bentonville, AR

2. Commissioning during Planning and Design

Caleb Carl Nelson, P.E., Member, CTA, Missoula, MT

3. Commissioning during Construction and Installation

Bryan Beitler, P.E., Member, Source Refrigeration and HVAC, Anaheim, CA

4. Commissioning During Start-up and First-Year Operation

Jason Robbins, P.E., Member, Walgreens, Springfield, IL

Wednesday, July 2

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 8 (INTERMEDIATE)

Computational Fluid Dynamics and Hand Calcs: Fan Pressure, Duct Fittings and Smoke Control

Track: Research Summit

Room: 611

Sponsor: 05.06 Control of Fire and Smoke, 05.01 Fans

Chair: William A. Webb, P.E., Fellow ASHRAE, WEBB FIRE Protection Consulting, LLC, Brooksville, FL

When analyzing the effects of air flow and pressures within a duct or a large open space, analytics or CFD modeling can be utilized. In this session, the improved computational relations, effects of airflow disturbances and smoke control are addressed.

1. Improvement of Computational Relations for Fan Pressures in HVAC Systems (SE-14-027)

Mikhail Nudelman, Hill Mechanical Services, Vernon Hills, IL

2. Analyzing the Effects of Air Flow Disturbances on Measurement and Control Equipment Positioned Downstream and Close to an Air Duct Elbow for the Purpose of Optimizing System Performance Using a CFD Technique (SE-14-028)

Ali Hasan, Parsons Int. Inc., Doha, Qatar



8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 13 (INTERMEDIATE)

Natural Ventilation, Underfloor Air Distribution, Dilution Ventilation Systems and Thermal 3D Modeling

Track: Research Summit

Room: 603

Chair: Bass Abushakra, Ph.D., P.E., Member, Milwaukee School of Engineering, Milwaukee, WI

With the focus on low energy and sustainable buildings today, building designers, engineers and researchers alike increasingly attempt to incorporate natural ventilation, UFAD and whole building dilution in innovative building practices. Implementing effective energy saving measures for the building's



HVAC system can reduce building energy consumption, reduce peak demand and improve building comfort for the occupants. A fully automatic approach to constructing a 3D thermal model of the building interior, which can potentially be used for automated building retro-commissioning, is addressed.

1. Development of Empirical Occupancy Diversity Profiles for Office Environments Using Information Communication Technology Systems (SE-14-C053)

Hu Huafen, Ph.D., Associate Member, Chad Miller, Student Member and Phan Stephen, Student Member, Portland State University, Portland, OR

2. Wind-Driven Airflow through Various Building Openings: Preliminary Results from Experimental Fluid Mechanics Using Particle Image Velocimetry (SE-14-C054)

L. James Lo, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

3. Automatic Generation of Thermal 3D Point Clouds of Building Interiors (SE-14-C055)

Omar Oreifej, Ph.D. and Avideh Zakhor, Ph.D., University of California, Berkeley, Berkeley, CA

4. Performance Study of an Underfloor Air Distribution System in an Education Building to Identify Building Energy Efficiency Improvement Opportunities (SE-14-C056)

Juan Zhao, Ph.D., Associate Member, Vasily Khmelenko and James Watt, Energy Systems Laboratory, Texas A&M University, College Station, TX

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 14 (INTERMEDIATE)

Radiant Cooling, District Energy and Multi-Objective Optimization

Track: Research Summit

Room: 612

Sponsor: 07.06 Building Energy Performance

Chair: Michael Pate, Ph.D., P.E., Member, Texas A&M University, College Station, TX

Residential buildings with high performance thermal enclosures and thermal mass have been demonstrated to have minimal (3-4°F) daily temperature swings. When such buildings are constructed on concrete slab foundations, it is possible to cool the mass using radiant distribution and to utilize the floor mass to delay the delivery of cooling to times when lower outdoor temperatures favor the performance of air-to-water vapor compression cooling systems (chillers or reverse cycle heat pumps). District energy refers to the supply of electricity and thermal energy (chilled water and hot water) to individual buildings from a central plant using a hydronic system in which pipes go underground. This session also investigates the extent to which the procedure options of stepwise regression analysis influence the measurements of variables sensitivities.

1. Improving EER with Off Peak Radiant Cooling (SE-14-C057)

David Springer, Member, Davis Energy Group, Davis, CA

2. Investigating the Potential of Residential District Energy (SE-14-C058)

Nelson Fumo, Ph.D., Member¹, Vicente Bortone, P.E.², Juan Carlo Zambrano, P.Eng., Affiliate³ and Aleyani Zambrano³, (1)The University of Texas at Tyler, Tyler, TX, (2)Johnson Controls Inc., Lenexa, KS, (3) Universidad Nacional Experimental del Táchira, San Cristobal, Venezuela

3. Polymeric Hollow Fiber Heat Exchangers: Liquid-to-Gas Application (SE-14-C059)

Ilya Astrouski and Miroslav Raudensky, Brno University of Technology, Brno, Czech Republic

4. A Comparison of Approaches to Stepwise Regression Analysis for Variables Sensitivity Measurements Used with a Multi-Objective Optimization Problem (SE-14-C060)

Mengchao Wang and Jonathan Wright, Loughborough University, Loughborough, United Kingdom



8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 15 (INTERMEDIATE)

Retro-Commissioning Effectiveness

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 606



Sponsor: 07.09 Building Commissioning, TRG7 Tools for Sustainable Building Operations, Maintenance and Cost Analysis

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

Retro-commissioning, as a systematic process for identifying and improving less-than-optimal energy performance in an existing building's equipment and control systems, is arguably one of the most cost effective strategies for reducing energy consumption in buildings. Possible detectable HVAC deficiencies in energy consumption data are explored. Development of a building cluster emulator for building/building and building/grid operation optimization will be introduced. If not operated according to the design, passive design strategies could reverse energy savings to energy consumptions. Most of the times commissioning identifies the almost inevitable "drift" in HVAC system operation from its design specifications and the measures and then put in place to ensure that HVAC system is performing as close as possible to its optimum.

1. Residential HVAC Commissioning through Energy Consumption Data Analysis (SE-14-C061)

Kristen S. Cetin, Student Member and Atila Novoselac, Ph.D., Member, University of Texas at Austin, Austin, TX

2. Corridor Pressurization System Performance in Multi-Unit Residential Buildings (SE-14-C062)

Lorne Ricketts, Student Member and Graham Finch, P.Eng., Associate Member, RDH Building Engineering Ltd., Vancouver, BC, Canada

3. The Potential Energy Efficiency of a Hybrid Designed House: A Post-Occupancy Case Study on the Heating and Cooling System (SE-14-C063)

Shan He and Ulrike Passe, Iowa State University, Ames, IA

4. The Investigation into Retro-Commissioning Effectiveness in Tropical Climate (SE-14-C064)

Ljiljana Marjanovic-Halburd, Ph.D.¹ and Challa Venu Kumar, Member², (1)UCL (University College London), London, United Kingdom, (2)Energy Conservation.Sg (Comfort Management Pte. Ltd.), Singapore, Singapore

8:00 AM-9:30 AM

SEMINAR 40 (INTERMEDIATE)

Ground Source Systems Commissioning and Closeout: Unique Issues, Avoiding Fatal Flaws and Ensuring Client Satisfaction

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications, 07.09 Building Commissioning

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

High performance ground source systems require a little tender, loving care (TLC) to properly bring them online and ensure that the system meets the design intent and owner's needs. This process begins during the design phase and continues through construction and start-up. The design team, commissioning agent and general contractor need to be invested and engaged with the project. Attention to detail and communication between the owner, design team, commissioning agent and contractor permits continuous improvement and prevents poor performance and an unhappy client. Properly executed, this will result in a well-tuned building system and a happy client. This seminar addresses some of the to-dos and not-to-dos during the process.

1. Commissioning and Close-out Tips for Geothermal Heat Pump Systems: Addressing GHP Nuances to Meet the Design Intent and Owners Project Requirement

Michael Kuk, Member, CERx Solutions, Oswego, IL

2. Best Practices for a Well-Integrated Geothermal Heat Pump System

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

3. Did the Client Get What they Were Promised?

Kent T. Bell, P.E., Member, Harris Consulting Engineers, Las Vegas, NV



8:00 AM-9:30 AM

SEMINAR 41 (INTERMEDIATE)

Optimized Controls Strategies for Radiant Heating and Cooling

Track: HVAC&R Fundamentals and Applications

Room: 608

Sponsor: 06.05 Radiant Heating and Cooling

Chair: Michael P. O'Rourke, Member, Barcol-Air Ltd., Denver, CO

This seminar presents real world design examples of applying controls to ensure energy efficiency in radiant heating and cooling projects. Issues such as zoning, ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy, requirements as well as discussions of condensation controls and low mass vs. high mass systems control issues are presented.

1. Condensation Avoidance and Optimizing Radiant Controls for Radiant Slab Systems

Daniel H. Nall, P.E., Member, Thornton Tomasetti Group, New York, NY

2. Residential Controls for Active Radiant Systems

Gary Hayden, P.E., Member, gbH Engineering PLLC, Norfolk, VA

3. Occupant Comfort Control through Radiant Systems

Peter Simmonds, Ph.D., Fellow ASHRAE, Stantec, Sherman Oaks, CA

4. Control of Radiant Systems for Energy Efficiency

Peter Rumsey, Rumsey Energy Innovations, Oakland, CA



8:00 AM-9:30 AM

SEMINAR 42 (INTERMEDIATE)

Performance Monitoring: Get the Energy Savings You Were Promised

Track: Installation, Commissioning, Operation, Maintenance of Existing Buildings

Room: 607

Sponsor: 01.04 Control Theory and Application

Chair: Marcelo Acosta, P.Eng., Member, Armstrong Fluid Technologies, Toronto, ON, Canada

Current energy performance standards require complex systems which more often than not are misunderstood by the construction, operations and maintenance teams. This leads to buildings never performing as promised or beginning to underperform soon after commissioning due to undetected malfunctions and operation misunderstandings. Three speakers present: the findings of an extensive study by Berkeley University quantifying the resulting energy waste; available solutions of different complexity and effectiveness; a successful solution implemented in large university campus in Massachusetts; and how the new ASHRAE Guideline 13P, Specifying Building Automation Systems, section on performance monitoring facilitates including preventive measures into building systems design.

1. Monitoring Based Commissioning: A Must in a World of High Energy Efficiency

Mark Gallagher, Member, Armstrong Fluid Technologies, Toronto, ON, Canada

2. Achieve Savings and Rebates: Using Automated Diagnostics

Dr. Nicholas T. Gayeski, Ph.D., KGS Buildings, LLC, Cambridge, MA

3. Specifying Performance Monitoring with ASHRAE Guideline 13

Dave Kahn, P.E., Member, RMH Group, Lakewood, CO



8:00 AM-9:30 AM

SEMINAR 43 (INTERMEDIATE)

Extending ASHRAE's Impact: How Savings Verification Software Tools Implement Guideline 14's Methods to Raise Investor Confidence

Track: Standards, Guidelines and Codes

Room: 609

Sponsor: 04.07 Energy Calculations

Chair: Chris Balbach, P.E., Member, Performance Systems Development, Ithaca, NY



ASHRAE Guideline 14, Measurement of Energy and Demand Savings, provides savings verification methods that increase investor confidence in building efficiency projects. However, widespread acceptance of its methods is still lacking. Open-source and proprietary software verification tools have gained popularity and bridge this gap, but stakeholders have little guidance in assessing their accuracy. This seminar demonstrates two public domain tools capable of generating ASHRAE compliant savings estimates. A recently completed project that developed methods and a protocol for testing these tools are discussed. The need for a standard method of test for inverse modeling tools, akin to ASHRAE Standard 140, Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs, is explored.

1. User-Friendly Measurement and Verification Based on ASHRAE Guidelines with a Free and Flexible Spreadsheet Add-in

Burr Vogel, NSA Bethesda, Bethesda, MD

2. Cost-Effective Accurate and Free Public Domain Building Energy Performance and Savings Analysis Tool

David A. Jump, Ph.D., P.E., Member, Quantum Energy Services & Technologies, Inc., Berkeley, CA

3. Unlocking Automated M&V: Assessment of Energy Baseline Model Accuracy

Jessica Granderson, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 16 (INTERMEDIATE)

Demand Shifting, Duct Sealing and Particulate

Concentrations: Three Peas in a Pod?

Track: Research Summit

Room: 611

Chair: Gary C. Debes, Member, Coward Environmental Systems, Coatesville, PA



This eclectic session starts with a new use of phase change materials to shift demand in cold storage facilities. Next come results from measurement of different sizes of particulate concentrations in two dozen hospital rooms followed by results from applying and testing a new duct sealing technology suitable for use in ducts with large leaks. What connects these papers? Each presents significant research results without a close companion topic among the research papers submitted to the conference!

1. A Paradigm Shift in Cold Storage Design: Using Thermal Mass and Phase Change Materials to Shift Demand off-Peak (SE-14-C065)

R., Gary Black, P.E.¹ and Raymond C. Cole, P.E., Member², (1)University of California, Berkeley, CA, (2)Axiom Engineers, Monterey, CA

2. Airborne Particulate Concentrations in Hospital Rooms (SE-14-C066)

Larry Dlugosz, Ph.D., Member, NOAA, Silver Springs, MD

3. Cost Effective Lining Technology for Sealing and Rehabilitation of Deteriorated HVAC Ducts (SE-14-C067)

Ashis Kumar Roy¹, Chris Bartlett¹, Shaurav Alam, Ph.D.¹, Erez N. Allouche, Dr.Eng., P.Eng.¹ and Ravi Gorthala, Ph.D.², (1), Louisiana Tech University, Ruston, LA, (2)Steven Winter Associates Inc., Norwalk, CT

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 17 (INTERMEDIATE)

Improving on the Fundamentals

Track: HVAC&R Fundamentals and Applications

Room: 606

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment



These papers explore changes in three areas of fundamentals: ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy, for thermal comfort and airflow perception; new methods for evaluating sound in ductwork; and energy conservation measures that utilize voltage reductions in residential air-conditioning systems.

1. Airflow Perception and Draught Rating for Varying Thermal Conditions (SE-14-C068)

Ahmet Ugursal, Ph.D., Charles Culp, P.E., Fellow ASHRAE and Louis G. Tassinary, Ph.D., Texas A&M University, College Station, TX

2. Residential Split-System Performance in Utility Voltage Reduction Operation (SE-14-C069)

Anish Gaikwad, Tom Short, John Bush, Associate Member and Ron Domitrovic, Ph.D., Member, EPRI, Knoxville, TN

3. Analysis of Flow, Temperature and Sound Propagation in HVAC Ducts Using Two-Ports (SE-14-C070)

Tamer Elnady, Ph.D.¹, Mina Wagih¹ and Mats Åbom, Ph.D.², (1)Ain Shams University, Cairo, Egypt, (2)KTH-Marcus Wallenberg Laboratory, Stockholm, Sweden

9:45 AM-10:45 AM

SEMINAR 44 (BASIC)

Basics of HVAC Noise Control: Environmental Noise Impact and Mitigation

Track: HVAC&R Fundamentals and Applications

Room: 609



Sponsor: 02.06 Sound and Vibration Control

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

Environmental noise from exterior and exterior ventilating equipment is a common challenge and issue for engineers and equipment manufacturers. This session explores the current and future of environmental noise codes; how the presence of tones in environmental noise is a common cause for complaints; and feasible noise control options for the exterior equipment.

1. Environmental Noise Codes: Current and Future

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

2. The Presence of Tones in Environmental Noise

Jennifer Francis, Student Member and Lily M. Wang, Ph.D., Member, (1)University of Nebraska - Lincoln, Omaha, NE

3. Noise Control Solutions for Rooftop Equipment

Dan LaForgia, Member¹ and Sami Elkhazin², (1)Vibro-Acoustics, New York City, NY, (2)Vibro-Acoustics, Markham, ON, Canada

9:45 AM-10:45 AM

SEMINAR 45 (INTERMEDIATE)

Central Plant Ground Coupled Heat Pump Systems

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research

Room: Ballroom 6B



Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Michel Bernier, Ph.D., Member, Ecole Polytechnique De Montreal, Montreal, QC, Canada

Central plant GCHP systems use central water-to-water equipment to move thermal energy between the ground coupled heat exchanger, a chilled water loop and a hot water loop. Here, the term 'central plant' implies the mechanical equipment is in one centralized location and does not imply a campus is served. Real-life examples of central plant GCHP systems are presented in this seminar with an emphasis on design issues and on potential advantages of such system over decentralized GCHP systems.

1. Central Plant GSHPs: Basic Considerations and Approaches

Scott P. Hackel, P.E., Associate Member, Energy Center of Wisconsin, Madison, WI

2. Central Plant GCHP for High Energy Efficiency Commercial Buildings

Roland Charneau, P.Eng., Fellow ASHRAE, Pageau Morel et Associés Inc., Montreal, QC, Canada

9:45 AM-10:45 AM

SEMINAR 46 (ADVANCED)

Modeling Industrial Spaces

Track: Indoor Environment – Health, Comfort and Productivity

Room: 603

Sponsor: 04.10 Indoor Environmental Modeling

Chair: Chao-Hsin Lin, Ph.D., Fellow ASHRAE, The Boeing Company, Seattle, WA



There are specific ventilation requirements for various industrial indoor environments. The objectives of this seminar are to share the experience of

applying numerical modeling techniques currently practiced or under development for industrial ventilation applications; and to demonstrate the state-of-the-art of industrial ventilation and environmental control by using computational fluid dynamics (CFD) tools and techniques.

1. Indoor Environment and Energy Analysis for a Winery Building
Qingyan Chen, Ph.D., Fellow ASHRAE, Purdue University, West Lafayette, WA

2. Exposure Control and Sustainability in Large Aircraft Painting Facilities
James S. Bennett, Ph.D., Member, NIOSH, Cincinnati, OH

3. Reducing Hazardous Fume Concentration in Industrial Workplaces by CFD Analysis
Reza Ghias, Ph.D., Member, Southland Industries, Dulles, VA

9:45 AM-10:45 AM

SEMINAR 47 (BASIC)

Radiant Heating and Cooling System Design 101: A Step-by-Step Approach

Track: HVAC&R Fundamentals and Applications



Room: 608
Sponsor: 06.05 Radiant Heating and Cooling
Chair: Devin A. Abellon, P.E., Member, Uponor, Phoenix, AZ

The seminar takes designers through a step-by-step thermal to hydraulic calculation for a single zone embedded pipe radiant floor heating and cooling zone. Included is discussion on how to use the Figure 9 Design Graph for Sensible Heating and Cooling with Floor and Ceiling Panels from the ASHRAE Handbook, HVAC Systems and Equipment.

1. 12 Step Design Process for Embedded Pipe Radiant Systems
Robert Bean PL(Eng.) R.E.T., Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

9:45 AM-10:45 AM

SEMINAR 48 (INTERMEDIATE)

Successfully Applying Sorption Technologies for Fun and Profit

Track: HVAC&R Systems & Equipment



Room: 607
Sponsor: 08.03 Absorption and Heat Operated Machines
Chair: Ersin Gercek, P.E., Associate Member, Real Engineering Services LLC, Totowa, NJ

Recent developments from efforts to develop gas-fired water heaters for residential and commercial applications are presented. In addition, comprehensive design considerations for ammonia-water binary system equipment are introduced for commercial manufacturers.

1. Gas-Fired Heat Pump Water Heaters
Kyle Gluesenkamp, Ph.D., Student Member, Oak Ridge National Laboratories, Knoxville, TN

2. Design Considerations for Ammonia-Water Binary System Equipment for Commercial Manufacturers
Samuel Leggett, Associate Member, Luvata HTS Americas, Grenada, MS

9:45 AM-10:45 AM

WORKSHOP 11 (INTERMEDIATE)

Achieving High Delta T: Keys to High Performance District Energy Systems

Track: HVAC&R Fundamentals and Applications



Room: 612
Sponsor: 06.02 District Energy
Chair: Lucas B. Hyman, P.E., Member, Goss Engineering, Inc., Corona, CA; John S. Andrepont, Life Member, The Cool Solutions Company, Lisle, IL

This workshop addresses the topic of water temperature differential (delta T) and its impact on district energy (hot and chilled water) systems. The impact of delta T is amplified in district energy systems. The workshop discusses issues resulting from poor delta T in a district energy system including a reduction in capacity and an increase in pumping energy. Common

causes of low delta T are discussed along with mitigation strategies through two case studies that demonstrate how system delta T can be improved and even surpass design delta T, including how thermal storage benefits from high system delta T.

1. Case Study: Etihad Towers in Abu Dhabi
Eric Moe, FVB Energy, Bainbridge Island, WA

2. Case Study: Los Angeles International Airport
Steve Tredinnick, P.E., Member, Burns & McDonnell, Chicago, IL

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 9 (INTERMEDIATE)

Optimization of Ground Coupled Heat Exchangers and Heat Pumps

Track: Ground Source Heat Pumps: State of the Art Design, Performance and Research



Room: Ballroom 6B

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications, 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

The first presentation presents the time constant modeling of geothermal heat pumps at compressor start up. Optimizing the control of ground coupled heat pump systems requires consideration of the building dynamics, to maintain thermal comfort, and the borehole heat exchanger dynamics, to exploit seasonal underground thermal energy storage. The second presentation shows how the number and positioning of boreholes for a given land surface area can affect the fluid and ground temperature variations and the required borehole length.

1. One and Two Time Constant Models to Predict the Capacity of Geothermal Heat Pumps in Cycling Conditions (SE-14-029)

Michel Bernier, Ph.D., Member, Ecole Polytechnique De Montreal, Montreal, QC, Canada

2. Analysis of the Energy Performance and Control Optimization of a Ground Source Heat Pump Installation (SE-14-030)

Javier Cervera Vazquez and Carla Montagud, Ph.D., Universitat Politecnica de Valencia, Valencia, Spain

3. Should the Optimization Horizon in Optimal Control of Ground Coupled Heat Pump Systems Cover the Inter-seasonal Time Scale? (SE-14-031)

Stefan Antonov, KU Leuven, Heverlee, Belgium

4. Experimental Validation of Ground Heat Exchanger Design Methodologies Using Real Monitored Data (SE-14-032)

James R. Cullin, Student Member, Oklahoma State University, Stillwater, OK

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 10 (INTERMEDIATE)

Control Theories: Tested

Track: Indoor Environment – Health, Comfort and Productivity



Room: 603
Sponsor: 01.04 Control Theory and Application
Chair: Frank Shadpour, P.E., Fellow ASHRAE, SC Engineers, Inc., San Diego, CA

The five papers presented in this session provide an array of control strategies to improve how they operate. Analysis and research is shared in regard to calibration and accuracy, air side economizers, energy reduction and adaptive logic.

1. Reducing Energy in HVAC Engineering (SE-14-033)
KH Chan

2. Sensor Data Management, Validation, Correction and Provenance for Building Technologies (SE-14-034)

Charles Castello, Ph.D., Affiliate, Oak Ridge National Laboratory, Oak Ridge, TN

3. Energy Analysis, Optimal High Limit Control and Engineering Approach of Air-Side Economizers (SE-14-035)
Gang Wang, Ph.D., P.E., Member, University of Miami, Coral Gables, FL

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 11 (INTERMEDIATE)

Improving Building Energy Consumption

Track: HVAC&R Fundamentals and Applications

Room: 612



Sponsor: 04.07 Energy Calculations, 06.09 Thermal Storage

Chair: Daniel E. Fisher, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

The papers in this session are focused on energy consumption and value: the benefits of ice storage systems; using energy simulation to address building energy; and analyzation of business value models for a true representation of the financial goals of the study.

1. Improving Accuracy of Building Energy Modeling Simulation Programs with Weather File Compensation Factors (SE-14-036)

Benjamin Weil and L. Carl Fiocchi, University of Massachusetts, Amherst, MA

2. Business Value as the Driver for Management of Building Energy Assets (SE-14-037)

Niloofer Salahi, Rutgers, the State University of New Jersey, Piscataway, NJ

3. Optimizing Building Energy Footprint Using Integrated Reliability and EnergyPlus Simulation Approach (SE-14-038)

Khashayar Mahani, Rutgers, the State University of New Jersey, Piscataway, NJ

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 18 (INTERMEDIATE)

Fundamentally Important Design Issues

Track: HVAC&R Fundamentals and Applications

Room: 608



Sponsor: 04.02 Climatic Information, 04.03 Ventilation Requirements and Infiltration

Chair: Jennifer E. Leach, P.E., Member, Cummins-Wagner Co, Inc., Annapolis Junction, MD

These papers span the breadth of fundamentals. Firstly by evaluating the tools used to determine loads: analyzing ASHRAE weather data including localized effects like urban heat island and the effects of moisture on porous insulation materials. Then case study analysis of tunnels on I-90 in Seattle review smoke management after adding high occupancy vehicle (HOV) lanes and the balance of ventilation and fire suppression in life safety measures.

1. Smoke Management Systems Upgrades for I-90 Tunnels in Seattle (SE-14-C071)

Igor Maevski, Member¹, Bob Josephson, P.E.², Raymond C. Klein, P.E., Member¹, Yuan Li, P.E., Member¹, Doug Haight, P.E.³, Zak Griffith, P.E.³ and Jarrod Alston, P.E., Member⁴, (1)Jacobs Engineering, New York, NY, (2) Jacobs Engineering, Seattle, WA, (3)WSDOT, Seattle, WA, (4)Arup, Cambridge, MA

2. The Effects of Ventilation Systems on Fixed Fire Suppression Systems in Tunnels (SE-14-C072)

David Byungin Hahm, Associate Member, Yuan Li, P.E., Member and Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY

3. Computational Fluid Dynamics Modeling of Moisture Evolution in Three Phases Subject to Sharp Change of Boundary Temperature (SE-14-C073)

Lei Chen, Tengfei Zhang, Ph.D., Member and Shugang Wang, Ph.D., Dalian University of Technology, Dalian, China

4. An Evaluation of ASHRAE's Climatic Design Conditions Against Actual Long-Term Recorded Weather Data (SE-14-C074)

Joe Huang, Member, White Box Technologies, Moraga, CA

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 19 (INTERMEDIATE)

HVAC Systems and Equipment Analysis

Track: HVAC&R Systems & Equipment

Room: 607



Chair: Kevin Gallen, Gallen Engineering, NA, OK

This session explores the operation of variable refrigerant flow (VRF) heat pumps, underfloor air distribution (UFAD), solar assisted residential

micro-trigeneration, wasting of water and energy in residential hot water distribution systems and thermal load error propagation due to inaccurate input information in commercial buildings.

1. Error Propagation In Commercial Building Load Calculation (SE-14-C075)

Sergio Escobar, Ph.D., Associate Member, Amip Shah, Cullen Bash and Niru Kumari, Hewlett-Packard, Palo Alto, CA

2. Field Comparison Study Of Indoor Environment Quality In Office Buildings With Underfloor Air Distribution and Overhead Ventilation Systems (SE-14-C076)

Boualem Ouazia, Ph.D.¹, Alexandra Thompson, Ph.D.¹, Daniel Booth, P.Eng.¹ and Michel Tardif, P.Eng., Member², (1)National Research Council Canada, Ottawa, ON, Canada, (2)CanmetENERGY Natural Resources Canada, Ottawa, ON, Canada

3. Energetic, Environmental and Economic Modelling of a Solar Assisted Residential Micro-Trigeneration System in a Mediterranean Climate (SE-14-C077)

Simon Paul Borg, Ph.D.¹, Nicolas James Kelly, Ph.D.² and Vincent Buhagiar, Ph.D.¹, (1) University of Malta, Msida, Malta, (2) University of Strathclyde, Glasgow, United Kingdom

4. Near Real-Time Monitoring of Residential Hot Water Distribution System Performance (SE-14-C078)

J.D. Lutz, P.E., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

5. A New Model to Simulate Energy Performance of VRF Systems (SE-14-C079)

Tianzhen Hong, Ph.D., P.E., Member¹, Xiufeng Pang, Ph.D., P.E., Member¹, Oren Schetrit¹, Liping Wang, Ph.D., P.E.¹, Shinichi Kasahara², Yoshinori Yura² and Ryohei Hinokuma³, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Daikin Industries, Osaka, Japan, (3)Daikin US Corporation, Irvine, CA

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 20 (INTERMEDIATE)

New Professional Skills, Codes and Ethics

Track: Standards, Guidelines and Codes



Room: 611

Sponsor: 01.07 Business, Management & General Legal Education

Chair: Chris Balbach, P.E., Member, Performance Systems Development, Ithaca, NY

To fulfill the demand for zero energy buildings, there is a need for synergy between the architectural and engineering domain. This has consequences for the engineers involved; they have to operate early in the conceptual building design process and act more as designers and less as traditional calculating engineers. Designers that adhere to the Water Efficiency recommendations listed in ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings and the International Green Construction Code from the International Code Council should see positive results in their water use calculations for commercial building applications that utilize energy efficient cooling towers, closed circuit coolers and evaporative condensers for their HVAC systems. This session shows, for first time through actual residential energy use data, that the implementation of the codes are yielding the energy reductions that were expected, which have significant impact on the state of Texas. This session reviews and explores typical state ethics codes and provides real-world ethics examples. Topics include specification writing; submittal reviews; and serving multiple entities on the same project.

1. Interpreting and Applying Cooling Tower Water Efficiency Design Recommendations in Sustainable Building Codes (SE-14-C080)

Daryn S. Cline, Member, EVAPCO, Inc., Taneytown, MD

2. Ethical Practice for Consulting Engineers (SE-14-C081)

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

3. Verification of the Energy Savings from the Implementation of the Residential Building Codes in Texas (SE-14-C082)

Juan-Carlos Baltazar, Ph.D., Chunliu Mao, Student Member and Jeff Haberl, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX

11:00 AM-12:30 PM
SEMINAR 49 (BASIC)

Air to Air Energy Recovery Ventilation Standards Overview including the Applicable ASHRAE 90.1 Changes and the Upcoming ISO Standard

Track: *Standards, Guidelines and Codes*



Room: 609

Sponsor: **05.05 Air-to-Air Energy Recovery**

Chair: *Ronnie Moffitt, P.E., Member, Trane, Inc., Lexington, KY*

The session educates attendees on the standards and guideline applicable to air-to-air energy recovery, including ASHRAE/IES Standard 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings; Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standard 1060, Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment; AHRI Guideline W, Selecting, Sizing, & Specifying Packaged Air-To-Air Energy Recovery Ventilation Equipment; and AHRI Guideline V, Calculating the Efficiency of Energy Recovery Ventilation and Its Effect on Efficiency and Sizing of Building HVAC Systems. Also presented are benefits of the AHRI Energy Recovery Ventilators (ERV) Certification Program. Attendees learn how to calculate energy savings using the certified ratings and what sets certified manufacturers apart. A review of ASHRAE Standard 84-2013, Method of Testing Air-to-Air Heat/Energy Exchangers, is presented as well as a preview of ISO Standard 16494, Heat recovery ventilators and energy recovery ventilators -- Method of test for performance.

1. 90.1-2013 Changes Related to Air-to-Air Energy Recovery

Paul Pieper, P.Eng., Member, Venmar CES, St-Leonard-d'Aston, QC, Canada

2. Benefits of the AHRI ERV Certification Program

Helen Davis, P.E., Member, AHRI, Arlington, VA

3. Overview of ASHRAE 84-2013 and Preview of ISO-16494

Matthew L. Friedlander, Member, RenewAire LLC, Madison, WI

11:00 AM-12:30 PM

WORKSHOP 12 (BASIC)

You've Got it Under Control: Understanding Sequences of Operation

Track: *Installation, Commissioning, Operation, Maintenance of Existing Buildings*



Room: 606

Sponsor: **01.04 Control Theory and Application, 07.03 Operation and Maintenance Management**

Chair: *Angela Lewis, Ph.D., P.E., Associate Member, Facility Engineering Associates, Fairfax, VA; Michael Bobker, Member, CUNY Institute for Urban Systems, New York, NY*

Controls are integral to building design, commissioning and operations and maintenance. This workshop provides an interactive opportunity to learn about using owner project requirements to develop control sequences from experienced controls professionals. After a brief overview of why controls are important and control sequences, participants work in small groups to develop parts of control sequences for different building system scenarios, such as a basic fan, variable air volume and air cooled chiller with constant flow. This workshop is geared toward Young Engineers in ASHRAE (YEA) and those looking to gain basic knowledge of controls.

1. Why Controls Are Important

Gaylen Atkinson, Member, Atkinson Electronics, Salt Lake City, UT

2. An Overview of Sequences of Operation

Barry B. Bridges, P.E., Life Member, Sebesta Blomberg, Roseville, MN

STANDING COMMITTEE CHAIRS

As the 2013-14 Society year draws to a close here at the 2014 Annual Conference, I want to thank you for serving as a standing committee chair. Your assistance over the past year has been very important.

Our Society has a strong legacy, of which I'm proud to be a part. My father, Donald Bahnfleth, served as the Society's president in 1985-86. His presidential theme, Committed to Serve, focused on ASHRAE's obligation to work for the benefit of its membership, the industry and the public. It's a message that touched on the core of ASHRAE's mission and remains fresh and relevant today. Through my presidential theme, Shaping the Next, I have striven to build on that legacy. I sincerely appreciate your indispensable contributions to the progress we have made this year on many fronts.

My Presidency is at an end, but our work is not done. Our agenda for the future is ambitious: to further develop as a global organization; to broaden our scope to encompass the full building life cycle to help ensure that buildings perform as intended; to provide the technology and guidance to make indoor environments as comfortable, productive and healthy as possible while preserving the environment and conserving natural resources for the future; and to nurture the next generation of our industry's professionals and leaders. If we are to realize these goals, we need the energy and expertise of everyone in the built environment community – including yours. Thank you for helping us take on these challenges.

I look forward to the continued contributions of our standing committee members as we move forward in shaping our future.

Sincerely,

William P. Bahnfleth, Ph.D., P.E., Fellow ASHRAE, ASME Fellow, 2013-14 ASHRAE President

Thomas H. Phoenix, Chair
Advocacy

T. Randall Jones, Chair
Building Energy Quotient

George W. Austin, Jr., Chair
Certification

Farooq Mehboob, Chair
Chapter Technology Transfer

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Spencer Morasch, Chair
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Pawel Wargocki, Chair
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T. David Underwood, Chair
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Hassan M. Bagheri, Chair
Handbook

Pamela M. Immekus, Chair
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Julian R. DeBullet, Chair
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Douglas D. Fick, Chair
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Ronald E. Jarnagin, Chair
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Publications

Richard R. Royal, Chair
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T. Agami Reddy, Chair
Research Administration

Jeff Clarke, Chair
Research Promotion

Steven T. Bushby, Chair
Society Rules

William F. Walter, Chair
Standards

Douglas F. Zentz, Chair
Student Activities

Walter T. Grondzik, Chair
Technical Activities

Bo W. Twumasi, Chair
Young Engineers in ASHRAE