

# 2020 Building Performance Analysis Conference and SimBuild

Co-organized by ASHRAE and IBPSA-USA

September 29th - October 1st, 2020



Approved for New York State Professional Development Hours (PDHs) and American Institute of Architects Learning Units (LUs)

## Tuesday, September 29

12:00 PM - 12:30 PM

**Keynote**

### Indoor Environmental Modeling and Covid-19

William P. Bahnfleth, Ph.D., P.E., Fellow ASHRAE, Pennsylvania State University, State College, PA  
The Covid-19 pandemic has focused attention on the importance of indoor air quality in a way that no prior event during the era of building performance simulation has done. In the search for good strategies to reduce indoor infection risk, many questions have arisen that in principle could benefit from indoor environmental modeling. This presentation considers the role modeling has played in responding to the pandemic, what issues that has raised about the current state of indoor air quality modeling, and what this experience suggests as aspirations and an agenda for future development of such tools.

12:30 PM - 1:45 PM

**Conference Paper Session 1 (Intermediate)**

### Grid Interactive Buildings

*Track: Low Carbon Future*



*Chair: Nicholas Long, Member, National Renewable Energy Laboratory, United States of America*

This session explores research and analysis in the field of demand flexibility and building-grid interactions. In addition to a deep dive in issues related to resiliency in cities and analysis capabilities in tools. Presenters showcase a novel approach for generating building load profiles through the Generative Adversarial Network and also the load flexibility potentials for ice energy storage systems. The issue of resiliency is explored through the lens of decentralized energy generation as well as analysis capabilities in tools including FEDS and MCOR Finally, this session discusses the use of model predictive control for analyzing building energy flexibility.

#### 1. Modeling the Load Flexibility Potentials for Ice Energy Storage (001)

*Karl William Heine, Student Member<sup>1</sup>, Paulo Cesar Tabares-Velasco, Ph.D.<sup>1</sup>, Ryan Meyer<sup>2</sup> and Michael Deru, Ph.D., Member<sup>2</sup>, (1)Colorado School of Mines, Golden, CO, (2)National Renewable Energy Laboratory, Golden, CO*

#### 2. Data-Driven Predictive Control for Commercial Buildings with Multiple Energy Flexibility Sources (002)

*Anjukan Kathirgamanathan, Student Member, Mattia De Rosa, Ph.D., Member, Eleni Mangina and Donal Finn, School of Mechanical and Materials Engineering, University College Dublin, Dublin, Ireland*

#### 3. Evaluating Facility Energy Efficiency and Resilience Opportunities with FEDS and MCOR (003)

*Varun Sood, Robert T Dahowski, Sarah F Newman and Travis C Douville, Pacific Northwest National Laboratory, Richland, WA*

#### 4. Characterization of Connected Lighting System Potential for Grid Services (004)

*Peng Wang, Michael Brambley, Ph.D., Fellow ASHRAE, Jianming Lian, Michael Poplawski, P.E., Michael Myer, Member, Sen Huang, Student Member, Robert Lutes and Alex Vlachokostas, Pacific Northwest National Laboratory, Richland, WA*

#### 5. A Framework For Delivering Energy Efficiency and Decentralized Energy Generation Projects to Tackle Fuel Poverty, Energy Resilience and CO2 Emissions in Cities (005)(P)

*Javier A. Urquizo Sr., Ph.D.<sup>1</sup>, Carlos Calderón<sup>2</sup> and Philip James<sup>2</sup>, (1)ESPOL, Guayaquil, Ecuador, (2)Newcastle University, United Kingdom*

## 6. Buildings-to-Distribution Network Integration to Enable Voltage Regulation Considering Renewable Energy Resources (006)(P)

*Hannah C. Fontenot, Student Member<sup>1</sup>, Krishna Sandeep Ayyagari<sup>2</sup>, Bing Dong, Ph.D., Associate Member<sup>1</sup>, Nikolaos Gatsis, Ph.D.<sup>2</sup> and Ahmad Taha, Ph.D.<sup>2</sup>, (1)Syracuse University, Syracuse, NY, (2)University of Texas at San Antonio, San Antonio, TX*

12:30 PM - 1:45 PM

### Conference Paper Session 2 (Intermediate)

#### Modeling Advances

*Track: New Technology and Trends*



*Chair: David Goldwasser, National Renewable Energy Laboratory, Golden, CO*

This session presents several advancements made in multiple facets of building performance modeling for optimizing and improving the efficiency of the modeling process. This session starts off with a discussion of the AIA 2030 Challenge and how an architectural firm revised its approach to building design to abide by the goals set forth by the 2030 challenge. It discusses a standardized framework for thermal resiliency modeling and analysis and discusses the development of a machine learning based optimization approach for building performance modeling. This session also discusses a way to reduce simulation time and cost by accurately simplifying building geometry.

#### 1. Optimal Efficiency and Operational Cost Savings: A Framework for Automated Rooftop PV Placement (007)

*Rawad El Kontar<sup>1</sup> and Xin Jin, Ph.D., Member<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)National Renewable Energy Laboratory, United States of America, Golden, CO*

#### 2. Towards a Standardized Framework for Thermal Resilience Modeling and Analysis (008)

*Ted Kesik, Ph.D., P.E.<sup>1</sup>, William O'Brien<sup>2</sup> and Aylin Ozkan, Ph.D.<sup>3</sup>, (1)University of Toronto, Canada, Toronto, ON, Canada, (2)Carleton University, Canada, (3)University of Toronto, Canada*

#### 3. Machine Learning Based Optimization Approach for Building Energy Performance (009)

*Aslihan Senel Solmaz, Ph.D., Dokuz Eylul University, Department of Architecture, Izmir, Turkey, Izmir, Turkey*

#### 4. Using Simplified Geometry to Improve Energy Modeling Efficiency and Reduce Cost (010)

*Yiyuan Jia, BEMP<sup>1</sup> and Fred Betz, Ph.D., Member<sup>2</sup>, (1)Affiliated Engineers, Madison, WI, (2)Affiliated Engineers, United States of America*

#### 5. A Common Language to Design Carbon Neutral Projects by 2030 (011)(P)

*Tommy Zakrzewski, Ph.D., BEMP, Associate Member, HKS, Inc., United States of America, Chicago, IL*

12:30 PM - 1:45 PM

### Seminar 1 (Intermediate)

#### Modeling Challenges for a Changing World

*Track: Energy Performance and System Simulation*



*Chair: David Eldridge Jr., P.E., Member, Grumman/Butkus Associates, Evanston, IL*

This session explores a process for calibrated energy modeling, the impact of using current weather data on simulation results and a case study that evaluates the impact of passive and tempering space conditioning strategies for a plant conservatory. As climate change continues to impact our energy modeling efforts, it becomes more important to have up to date weather information and to explore new strategies for natural ventilation in conjunction with other tactics to understand our opportunities in a changing world. This session also describes data collection efforts, model creation and monitoring to improve accuracy and calibration.

#### 1. Thermal Conditioning and CFD Analysis of a Conservatory

*Rufei Wang<sup>1</sup>, Nikolai Artmann<sup>2</sup> and Joseph Guida<sup>1</sup>, (1)Atelier Ten, New York, NY, (2)Atelier Ten, London, United Kingdom*

#### 2. Should I Care How Old My Climate Data Is?

*Drury Crawley, Ph.D., BEMP, Fellow ASHRAE<sup>1</sup> and Linda Lawrie, Member<sup>2</sup>, (1)Bentley Systems, Inc., Washington, DC, (2)DHL Consulting LLC, Pagosa Springs, CO*

#### 3. 801 Grand Case Study of a Calibrated Energy Model Supporting a Deep Retrofit

*David Stewart Eldridge Jr., P.E., BEAP, BEMP and HBDP, Member*

12:30 PM - 2:00 PM

### Panel 1 (Basic)

## Solution Room (LIVE)

Track: *New Technology and Trends*

Moderator: *Aaron Boranian, Big Ladder Software, Denver, CO*

This session is a format new to the conference in which attendees "crowd source" answers to their burning questions. It aims to provide a more interactive experience where each participant is given time to think of a challenge they are facing. Participants are then divided into groups and each person takes it in turns to present their problem and have it brainstormed by the group. This allows participants to seek out as well as provide peer-supported advice on solving each other's challenges. What answers will you find (or give) in the Solution Room?

Tuesday, September 29, 3:00 PM - 4:15 PM  
Conference Paper Session 3 (Intermediate)

## Daylighting

Track: *Health, Wellness and Comfort*



Chair: *Marty Brennan, ZGF ARCHITECTS LLP, Seattle, WA*

This session presents a deep dive into daylighting in the built environment through the lens of simulation, modeling, literature reviews, and case studies. Presenters examine different methods of daylighting analysis, including physical modeling and simulation based softwares, to understand how these tools perform and differ from each other. This session also goes through a review of human cognitive health and its relationship to daylighting. Finally, this session presents how these practices are put to use through case studies, looking at a multifamily residential unit in Seattle, along with daylighting and health modeling for vulnerable populations.

### 1. Daylight Availability and Occupant Visual Comfort in Seattle Multi-Family Housing (012)

*Guanzhou Ji, University of Washington, Seattle, WA*

### 2. Challenging Conventional Approaches for Climate-based Daylight SIMulations of Multi-Unit Residential Buildings (013)

*Terri Peters, Ph.D.<sup>1</sup>, Noor Alkhalil<sup>2</sup>, Kesik Ted<sup>2</sup> and O'Brien Liam<sup>3</sup>, (1)Department of Architectural Science, Ryerson University, Toronto, ON, Canada, (2)John H Daniels Faculty of Architecture, Landscape and Design, University of Toronto, Toronto, Canada, (3)Carleton University, ON, Canada*

### 3. The Solar Heliodon: Physical Simulation of Dynamic Daylighting Conditions in Scale Architectural Models for Subjective and Objective Human-Factors Evaluation (014)

*Kyle Konis, Ph.D., Member, University of Southern California, Los Angeles, CA*

### 4. A Framework to Simulate the Non-Visual Effects of Daylight on the Cognitive Health of Mild Cognitive Impairment (MCI) People (015)

*Nourhan Gamal Elsayed, Student Member and Tarek Rakha, Georgia Institute of Technology, Atlanta, GA*

### 5. Concerns with Spatial Daylight Autonomy Software Precision in Daylight Driven Design (016)(P)

*Kyleen H Rockwell, AIA, BEMP, Associate Member, HKS, Inc., United States of America*

3:00 PM - 4:15 PM

Conference Paper Session 4 (Intermediate)

## Electrification and Resiliency

Track: *Low Carbon Future*



Chair: *Lauren Wallace, The Epstein Group, Atlanta, GA*

This session discusses zero net energy approaches evaluated for homes in California, which can provide insights for T-24 development. Presenters discuss an analysis using housing stock energy models used to inform the decarbonization policy for housing developments. The next presentation covers a framework to characterize the demand response potential of residential buildings. The session also discusses the need for resilient communities with on-site PV and battery storage to prepare for natural and man-made disasters. Finally, this session looks into resilience and passive survivability in multifamily buildings to enable buildings to maintain desirable interior conditions during outages.

### 1. Cost-Effective Zero Net Energy Homes in California (017)

*Sang Hoon Lee, Max Wei and Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA*

### 2. Assessing Resiliency and Passive Survivability in Multifamily Buildings (018)

*Lisa M. White and Graham S Wright, PHIUS, Chicago, IL*

### **3. A Generic Energy Flexibility Evaluation Framework to Characterise the Demand Response Potential of Residential Buildings (019)**

*Adamantios Bampoulas, Student Member, Mohammad Saffari, Fabiano Pallonetto, Eleni Mangina and Donal P. Finn, University College Dublin, Dublin, Ireland*

### **4. Optimal Operation for Resilient Communities through a Hierarchical Load Scheduling Framework (020)**

*Jing Wang, Student Member<sup>1</sup>, Kaitlyn N. Garifi<sup>1</sup>, Kyri A. Baker<sup>1</sup>, Wangda Zuo, Ph.D., Member<sup>1</sup> and Yingchen Zhang<sup>2</sup>, (1)University of Colorado Boulder, Boulder, CO, (2)National Renewable Energy Laboratory, Golden, CO*

### **5. Evaluation of an Evolving Housing Stock: Scenarios towards its Decarbonisation (021)(P)**

*Gustavo Sousa, Ph.D., University of Sheffield, Sheffield, United Kingdom*

3:00 PM - 4:15 PM  
**Seminar 2 (Advanced)**

## **Urban-Scale Modeling**

*Track: Low Carbon Future*



*Chair: Drury Crawley, Bentley Systems, Inc., Washington, DC*

The session covers several urban scale case studies and example workflows. The first presentation presents real-world case studies using ResStock, which has recently been adapted for several regionally specific projects. The second covers an innovative existing multi-family smart urban energy district project in Germany, which integrates PV, heat pumps, CHP units, and district heating in existing multi-family houses. This session also presents a method-based framework for urban energy modeling, with a focus on dataset development and a real-world case study describing a simulation-informed workflow for establishing building performance specifications, right-sizing a district energy system, and deploying community-scale renewables.

#### **1. Urban-Scale Building Energy Modeling for Decarbonization and Renewable Energy Goals**

*Janet Lorel Reyna, Ph.D., Anthony Fontanini and Eric Wilson<sup>2</sup>, (1)NREL*

#### **2. Smart Urban Energy District of the Future: Integration of PV, Heat Pumps, CHP Units and District Heating in existing Multi-Family Houses in Germany**

*Manuel Lämmle, Dr.Ing.*

#### **3. A Framework for Urban Building Energy Model: Focus on Dataset Development**

*Rezvan Mohammadizazi and Melissa Bilec*

#### **4. Simulation Workflow for Community-Scale Energy System Design**

*Ajit Naik*

3:00 PM - 4:30 PM  
**Panel 2 (Basic)**

## **Building Simulation Competency: Crowded Curricula, Demanding Profession (LIVE)**

*Track: Codes & Standards and Programs*

*Chair: Ralph Muehleisen, Argonne National Laboratory*

In response to growing demand for building simulation professionals driven by an increased global focus on climate sustainability, domestic and international universities offer their students more simulation courses each year. Modifying university curricula is fraught with tradeoffs as general education credit requirements grow and total degree credit requirements shrink, minimizing students' opportunity to enroll in specialized courses teaching building simulation techniques. A panel of academic and industry practitioners discuss their experiences, problems, annoyances, strategies, solutions, and workarounds developed during their careers in the building simulation field.

#### **1. Building Simulation Competency: Crowded Curricula, Demanding Profession**

*Ajit Naik, Mohammad Heidarnejad, Ph.D., P.E., Associate Member<sup>2</sup> and Thomas Zakrzewski, (1)Illinois Institute of Technology, Chicago, IL*

Tuesday, September 29, 5:00 PM - 6:15 PM  
**Conference Paper Session 5 (Intermediate)**

## **Building Envelope and Occupant Behavior Impact**

*Track: Energy Performance and System Simulation*



*Chair: Susan Collins, Whole Building Systems, Charleston, SC*

This session explores different methods and practices to characterize and survey building envelopes. Presenters showcase literatures reviews on thermography-based methods to characterize thermal properties of building envelopes and nondestructive techniques for building envelope scanning and surveying. In addition, this session covers the impact of land use on the convective heat transfer from buildings. Finally, this session presents a review of multiple residential occupancy simulation techniques, a simulation-based workflow for identifying occupant presence, and impact analysis of demand response strategies based on a dynamic model of occupant thermal comfort behavior.

**1. A Building Envelope Characterization Workflow for In-Situ Thermal Performance Assessment (022)**

*Tyler Pilet, Student Member and Tarek Rakha, Georgia Institute of Technology, Atlanta, GA*

**2. Simulating False Sensing Impacts for Diverse Occupancy Patterns and Behaviors on Heating and Cooling Energy Consumption in United States Residential Buildings (023)**

*Tarek Ahmed Hussein Sherif and Tarek Rakha, Georgia Institute of Technology, Atlanta, GA*

**3. Review of Non-Destructive Techniques (NDTs) for Building Diagnostic Inspections (024)(P)**

*Yasser El Masri, Student Member and Tarek Rakha, Georgia Institute of Technology, Atlanta, GA*

**4. Numerical Investigation of External Convective Heat Transfer Coefficient for Buildings in Different Land Use Class (025)**

*Anwar Demsis Awol<sup>1</sup>, Girma Tsegaye Bitsuamlak<sup>1</sup> and Fitsum Tariku, Member<sup>2</sup>, (1)University of Western Ontario, London, Canada, (2)British Columbia Institute of Technology, Burnaby, BC, Canada*

**5. Impact Analysis of Personalized Thermostat Demand Response (026)**

*Kunind Sharma, Student Member and Michael Kane, Ph.D., Member, Northeastern University, Boston, MA*

5:00 PM - 6:15 PM

**Conference Paper Session 6 (Intermediate)**

**Modeling Advances-Radiation and Natural Ventilation**

*Track: New Technology and Trends*



*Chair: Wangda Zuo, University of Colorado Boulder, Boulder, CO*

This session introduces some new advancement in modeling naturally ventilated buildings and fast prediction of solar radiation to enable city scale modeling or model-based building control. Two papers will discuss new methods of modeling air flow with one focusing on residential buildings and the other for office buildings. For radiation modeling, one paper discusses how to pre-calculate the sunlit fractions in order to speedup EnergyPlus for urban scale modeling. The other two adopts Convolutional Neural Networks and artificial neural network to estimate the solar radiation.

**1. A Novel Approach to Modelling Air Flow Through Operable Windows in High-Rise Multi-Unit Residential Buildings Using Energy Plus (027)**

*Jamie Fine, Ph.D., Associate Member and Marianne Touchie, Ph.D., P.E., Associate Member, University of Toronto, Canada*

**2. Efficient Computation of Surface Sunlit Fraction in Urban-scale Building Modeling using Ray-tracing Techniques (028)**

*Xuan Luo, Yuhang Tang and Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, United States of America*

**3. A New Calculating Method of the Effect of Natural Ventilation Control in Office Buildings with Buoyancy Driven Ventilation (029)**

*Kei Shimonosono<sup>1</sup>, Kimiko Kohri, Ph.D., Member<sup>2</sup> and Hisaya Ishino, Ph.D.<sup>3</sup>, (1)Hokkaido Research Organization, Japan, (2)Utsunomiya University, Japan, (3)Tokyo Metropolitan University, Japan*

**4. Using 3D Convolutional Neural Networks to Estimate Annual Radiation Intensities on Building Facades (030)**

*Jung Min Han, Student Member<sup>1</sup>, Chih-Kang Chang<sup>2</sup> and Ali Malkawi<sup>3</sup>, (1)Harvard University Graduate School of Design, Cambridge, MA, (2)Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, MA, (3)Harvard Center for Green Buildings and Cities, Cambridge, MA*

**5. Verification of Ann Solar Radiation Prediction Algorithm for Real-Time Energy Simulation (031)**

*Hany Gaballa and Soolyeon Cho, Ph.D., Member, College of Design, NC State University, Raleigh, NC*

5:00 PM - 6:15 PM

**Seminar 3 (Intermediate)**

**Resiliency and Passive Survivability**

*Track: New Technology and Trends*



*Chair: Lauren Wallace, The Epsten Group, Atlanta, GA*

This session covers topics of resiliency and passive survivability in the face of a changing climate. The first presentation covers a futuristic design approach that integrates current technologies with those demanded by aerospace and hi-tech industries in the near future. The session also presents techniques to prepare for the negative impacts of extreme weather and climate change, explore passive thermal survivability of hospitals across U.S. climate zones, detail resilient HVAC systems to mitigate contagious diseases spread, and assess the potential for dynamic glazing to provide additional hours of occupancy by controlling the temperature drift.

**1. The Next Giant Leap: Tech Transfer for a Resilient Built Environment**

*Omar Hawit, P.E., Member, Terraform, Mission Viejo, CA*

**2. My Hospital Has Lost Power: Now What Can Simulation Prepare Me For?**

*Amir Rezaei-Bazkiaei, Ph.D., Associate Member, CannonDesign, New York, NY*

**3. Resilient HVAC Systems to Mitigate Contagious Diseases Spread**

*Sama Aghniaey, Ph.D., Member<sup>1</sup>, John G. Williams<sup>1</sup>, Luis Rivera<sup>2</sup> and Steven Chaitow<sup>3</sup>, (1)Harris, design studio, Oakland, CA, (2)Harris, United States of America, (3)Bohlin Cywinski Jackson, San Francisco, CA*

**4. Resiliency for Existing Buildings in the Face of Climate Change**

*Gord Rajewski and Mitchell Phillips*

**5. Impact of Dynamic Glazing on Thermal Resilience of Office Buildings**

*Ranojoy Dutta, BEMP and HBDP, Associate Member, 1529 FOUR OAKS CIR, SAN JOSE, CA*

5:00 PM - 6:30 PM

**Panel 3 (Intermediate)**

**Ask a Modeler LIVE!: Non-technical Communication for Building Performance Modelers (LIVE)**

*Track: Energy Performance and System Simulation*

*Chair: Nathaniel Jones, Ph.D., Associate Member, Arup, San Francisco, CA*

Communicating our work to non-technical audiences is important to the growth and recognition of the building performance simulation profession. This panel addresses how we talk about our work with non-experts - clients, students, family members, and the general public - with an eye toward improving visibility and community in our field.

**1. Ask a Modeler LIVE!: Non-technical Communication for Building Performance Modelers**

*Erik Kolderup, P.E., BEMP, Member<sup>1</sup>, Carrie Brown, Ph.D., Member<sup>2</sup>, Krishnan Gowri, Ph.D., Fellow ASHRAE<sup>3</sup>, Michael Sweeney, BEMP, Sara Motamedi and Nathaniel L Jones, Ph.D., Associate Member, (1)Kolderup Consulting, San Francisco, CA, (2)Resource Refocus, LLC, Oakland, CA, (3)Intertek, Bothell, WA*

**Wednesday, September 30**

11:00 AM - 11:30 AM

**Keynote**

**Action with Uncertainty**

*Chair: Andrew Lee, International Living Future Institute, Seattle, WA*

As the world's scientists call for more urgent climate action, the building industry is undergoing a rapid pivot from energy to carbon as a key metric to gauge success. This shift towards Zero Carbon buildings requires practitioners to quantify and reduce both operational and embodied carbon. Though with calls for action outpacing the data to inform it, how can our industry make the best carbon-focused choices? This talk unpacks that dilemma, reframes the narrative and shares examples of how teams are punching through the wall of uncertainty to move forward with authenticity.

11:30 AM - 12:15 PM

**Conference Paper Session 7 (Intermediate)**

**Data Exchange and Interoperability**

*Track: New Technology and Trends*



*Chair: Nathaniel Jones, Ph.D., Associate Member, Arup, San Francisco, CA*



This session discusses recent advancements in data exchange and interoperability to smoothen the process of building design, system monitoring, building auditing and retrofitting, as well as community and urban-scale energy system modeling. Various technique customized for different applications are discussed in this session, including Internet-of-Things home monitoring system with a DC nanogrid, integration of BuildingSync and OpenStudio, standard climate data model, URBANopt for community and urban energy system, as well as data-infused BIM.

**1. Design and Evaluation of a Decentralized and Distributed IoT Home Monitoring System within a DC Nanogrid (032)(P)**

*Jonathan Ore, Student Member and Eckhard A Groll, Purdue University, West Lafayette, IN*

**2. High-Level Model Articulation with BuildingSync and OpenStudio (033)(P)**

*Cory Mosiman<sup>1</sup>, Nicholas Lee Long<sup>1</sup>, Tobias Maile<sup>2</sup>, Katherine Fleming<sup>1</sup> and Christopher CaraDonna<sup>1</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)Digital Alchemy, United States of America*

**3. Towards a Standard Climate Data Model for Building Design and Analysis (034)**

*Sagar Rao<sup>1</sup> and Parag Rastogi, Ph.D., Member<sup>2</sup>, (1)NeuMod Labs, United States of America, (2)arbnco, United Kingdom*

**4. URBANopt: An Open-Source Software Development Kit for Community and Urban District Energy Modeling (035)**

*Rawad El Kontar, Ben Polly, Tanushree Charan, Katherine Fleming, Nathan Moore, Nicholas Long, Member and David Goldwasser, National Renewable Energy Laboratory, Golden, CO*

**5. Live BIM for Capturing Dynamics of Physical Spaces, Occupants and Assets, Using Linked Data (036)**

*Arash Hosseini Gourabpasi and Mazdak Nik-Bakht, Concordia University, Canada*

11:30 AM - 12:15 PM

**Conference Paper Session 8 (Intermediate)**

**HVAC Components and Systems Analysis**

*Track: Energy Performance and System Simulation*



*Chair: Mariah Schwartz, Whole Building Systems, LLC, Charleston, SC*

HVAC components and systems have consistently been an important area for building simulation development and applications. This session includes five papers that are related to modeling and performance analysis of HVAC components and systems. Addressed topics include demand-controlled ventilation for VAV systems, wood pellet boilers, domestic hot water heaters, desiccant-coated heat exchangers, and gas-fired Chemisorption heat pumps.

**1. Energy and Ventilation Performance Analysis for CO<sub>2</sub>-based Demand-Controlled Ventilation in Multiple Zone VAV systems with Multiple Recirculation Paths (037)**

*Xing Lu, Student Member<sup>1</sup>, Zheng O'Neill<sup>2</sup>, Xiaohui {Joe} Zhou<sup>3</sup> and Tao Yang, Student Member<sup>2</sup>, (1)Texas A&M University, College Station, TX, (2)University of Alabama, AL, USA, (3)Slipstream, Madison, WI, USA*

**2. A New Detailed Model of Wood Pellet Boilers (038)**

*Timothy P McDowell<sup>1</sup>, Khaled Yousef, P.E., Member<sup>2</sup>, John Siegenthaler, P.E., Member<sup>3</sup> and Thomas Butcher, Ph.D., Fellow ASHRAE<sup>4</sup>, (1)Thermal Energy System Specialists, LLC, United States of America, Lafayette, CO, (2)Pyramid Energy Engineering Services, PLLC, United States of America, (3)Appropriate Designs, United States of America, (4)Brookhaven National Laboratory, United States of America*

**3. Deriving Simulation Parameters for Storage-Type Water Heaters Using Ratings Data Produced from the Uniform Energy Factor Test Procedure (039)**

*Jeff Maguire and David Roberts, P.E., National Renewable Energy Laboratory, United States of America*

**4. Effect of Geometry and Operational Parameters on the Dehumidification Performance of a Desiccant Coated Heat Exchanger (040)**

*Ming Qu, Ph.D., Associate Member<sup>1</sup>, Tomas Pablo Venegas<sup>1</sup>, Kashif Nawaz, Ph.D., Member<sup>2</sup> and Lingshi Wang<sup>2</sup>, (1)Purdue University, United States of America, West Lafayette, IN, (2)Oak Ridge National Laboratory, Oak Ridge, TN*

**5. Seasonal Performance Simulation of a Gas-fired Chemisorption Heat Pump for Residential Heating in Cold Climate (041)**

*Zhiyao Yang, Student Member<sup>1</sup>, Ming Qu, Ph.D., Associate Member<sup>1</sup> and Kyle Gluesenkamp, Ph.D., Associate Member<sup>2</sup>, (1)Purdue University, West Lafayette, IN, (2)Oak Ridge National Laboratory, United State of America*

11:30 AM - 12:45 PM

**Seminar 4 (Intermediate)**

**Modeling is Helpful, Operations are Essential (Buildings are 'Tricksy')**

*Track: Energy Performance and System Simulation*



*Chair: James Dirkes, Foresight Management, Grand Rapids, MI*

This seminar evaluates limitations of performance models and how actual operation can differ from the model assumptions. Commissioning is the next step; essential for starting operations on the right foot and a confirmation that the facility is working as intended. The seminar also discusses best practices for assessing operations, determining where improvements can be made and evaluating whether the improvements are performing as desired.

**1. Modeling is Helpful, Operations are Essential (Buildings are 'Tricksy')**

*James Dirkes, Mike Troupos and Jeff Cheek*

11:30 AM - 1:00 PM

**Panel 4 (Intermediate)**

**Standards Making Your (Work)Life Better! (LIVE)**

*Track: Codes & Standards and Programs*

*Chair: Amir Roth, US Dept. of Energy*

There are many BEM industry consensus standards that strive to improve the quality, workflow, and tools across the industry. Some of these are an integral part of workflows like ASHRAE Standard 90.1. Some are dedicated to testing the capabilities of BEM software programs like ASHRAE Standard 140 and ASHRAE Standard 229. Some are striving to standardize the way data is communicated to/from BEM software programs to improve workflow for users like ASHRAE 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment and IBPSA-USA's Building Data Exchange (BDE) Committee.

**1. Standards Making Your (Work)Life Better!**

*Tim McDowell, Jason Glazer, P.E., Member<sup>2</sup>, Neal Kruis, Ph.D., Member<sup>3</sup>, Supriya Goel<sup>4</sup> and Sagar Rao, Member<sup>5</sup>, (1)GARD Analytics, Inc., Arlington Heights, IL, (2)Big Ladder Software, Denver, CO, (3)PNNL, (4)Affiliated Engineers, Inc.*

Wednesday, September 30, 1:15 PM - 2:30 PM

**Conference Paper Session 9 (Intermediate)**

**Balancing Indoor Environmental Quality and Energy**

*Track: Health, Wellness and Comfort*



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

This session explores the importance of balancing indoor environmental performance, including visual comfort, views, daylight, and thermal comfort, with load reduction and energy efficiency. Presenters highlight different innovative design methodologies and workflows for manipulating enclosures, optimizing double skin facades, parametric modeling, providing real-time feedback, and monitoring indoor environmental parameters. The session also includes case studies on existing building retrofits and multisport facilities in which these strategies have been deployed. Finally, this session presents a study on current IEQ requirements and how they impact other design parameters.

**1. A Rewarded-Project Story from Japan: Comfort Vs View in a Fancy Glazed Atrium (042)**

*Yasin Mohamed Ibrahim Idris, Dr.Eng, Nakagawa Hiroaki, Hajime Iseda, Nagata Takuya, Xu Tianshu, Kuniaki Ando and Kunihiko Fujiwara, TAKENAKA Corporation, Tokyo, Japan*

**2. The Case for Multicriteria Annual Sunlight Exposure Guidelines (043)**

*Belal Abboushi, Ph.D., Pacific Northwest National Laboratory, Portland, OR*

**3. Optimization of Double Skin Façades with Integrated Renewable Energy Source in Cold Climates (044)**

*Mostafa Mohamed Saad and Mohamad Tarek Araji, University of Manitoba, Winnipeg, MB, Canada*

**4. Development of a Fast Prediction and Interactive Design Method of Visual Comfort for Indoor Multisport Facilities Based on AcceleradRT Real-Time Simulation Feedback (045)**

*Yu Li, Ph.D. and Lingling Li, Harbin Institute of Technology; School of Architecture, Harbin, China*

1:15 PM - 2:30 PM

**Conference Paper Session 10 (Intermediate)**

**Calibration and Parametric Analysis**

*Track: Energy Performance and System Simulation*





Chair: Aaron Boranian, Big Ladder Software, Denver, CO

This session includes papers that explore the issues of model calibration, uncertainty and parametric analysis. Specific topics include the investigation of the use of tools with different resolutions for building performance rating, model calibration for IEQ and energy performance, the impact of future weather on building energy use, model validation under uncertainty, and the sensitivity analysis of design parameters on energy performance.

**1. Modeling and Simulation of a Campus Living Building: A Case Study In Uncertainty Analysis and Stress Testing (046)**

**Tanushree Charan**<sup>1</sup>, **Sol Haroon**<sup>2</sup> and **Godfried Augenbroe**<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)Georgia Institute of Technology, Atlanta, GA

**2. Improving Model Calibration Methods: A Case Study Application of Incorporating IEQ with Energy (047)**

**Nishesh Jain**<sup>1</sup>, **Esfand Burman**<sup>1</sup>, **Dejan Mumovic**<sup>1</sup>, **Michael Davies**<sup>1</sup> and **Andy Tindale**<sup>2</sup>, (1)UCL Institute of Environmental Design and Engineering, London, United Kingdom, (2)DesignBuilder Software Limited, UK

**3. Nationwide Impacts of Future Weather on the Energy Use of Commercial Buildings (048)**

**Ralph Muehleisen, Ph.D., P.E., Member**<sup>1</sup>, **Qi Li, Ph.D.**<sup>2</sup>, **Rebecca Aloisio**<sup>3</sup> and **Michael Santana**<sup>4</sup>, (1)Argonne National Laboratory, Lemont, IL, (2)Argonne National Laboratory, Argonne, IL, (3)Edinboro University, Edinboro, PA, (4)University of Wisconsin, Platteville, WI

**4. Empirical Validation of Multi-Zone Building and HVAC System Models under Uncertainty (049)**

**Ralph Muehleisen, Ph.D., P.E., Member**<sup>1</sup>, **Qi Li, Ph.D.**<sup>2</sup>, **Piljae Im, Ph.D., Member**<sup>3</sup> and **Jaewan Joe**<sup>3</sup>, (1)Argonne National Laboratory, United States of America, Lemmon, IL, (2)Argonne National Laboratory, United States of America, (3)Oak Ridge National Laboratory, United States of America

**5. Ranking Energy Influential Parameters: How Building Type Affects the Parameters' Influence (050)**

**Rafaela Orenga Panizza** and **Mazdak Nik-Bakht**, Concordia University, Canada

1:15 PM - 2:30 PM

**Seminar 5 (Intermediate)**

**Elevating Energy Reduction Decisions**

Track: *New Technology and Trends*



Chair: Erik Kolderup, P.E., Member, Kolderup Consulting, San Francisco, CA

This session looks at a series of questions and workflows that drive energy reduction decisions around value and opportunity. One study looks at how hotel guests can become an obvious ECM while a zero energy case study turns to pre-occupancy, occupant engagement as part of a prescriptive energy model process. Another takes on the challenges of modeling existing buildings and how to transform utility data into a cascade of financial benefits. The session also includes a portfolio-wide benchmarking project of SFO airport which assesses design and operational upgrades along with process loads for ECMs.

**1. Conceptual Framework for Reducing Occupants Energy Consumption in Hotel Buildings**

**Hevar Palani**

**2. Portfolio Level Performance Assessment through Benchmarking: A Case Study of San Francisco International Airport**

**Raghuram Sunnam**<sup>1</sup> and **Samantha Sharma**<sup>2</sup>, (1)Rocky Mountain Institute, Oakland, CA, (2)Arup, San Francisco, CA

**3. Modeling Existing Buildings: A Data Primer**

**Christopher Pendley, Associate Member**

**4. Comparative vs Prescriptive Modeling: Designing a Zero Energy Building**

**Ivan Adriane Jose** and **John Kearns**

1:15 PM - 2:45 PM

**Panel 5 (Intermediate)**

**Decarbonizing: Chat with Toolmakers (LIVE)**

Track: *Low Carbon Future*

Chair: Marty Brennan, ZGF ARCHITECTS LLP, Seattle, WA

The AEC industry is undergoing a steep learning curve in carbon transparency, reduction and sequestration. No leaf goes unturned in the carbon balance sheet as cities, universities and businesses increasingly look to go net positive. The Simbuild steering Committee invites Toolmakers developing this practice to bring forward the questions, challenges and inspiration they see firsthand. These Toolmakers are decarbonizing leaders pioneering policies, design specifications, and certification systems. This will be a live conversation for the audience to get to know the panel and join in with questions.

**1. Decarbonizing: Chat with Toolmakers**

**Marty Brennan**<sup>1</sup>, **Karen Weigert**<sup>2</sup>, **Arathi Gowda**<sup>3</sup> and **Haley Gardner**<sup>4</sup>, (1)ZGF ARCHITECTS LLP, Seattle, WA, (2)Slipstream, Chicago, IL, (3)SOM, Chicago, IL, (4)International Living Future Institute, Seattle, WA

Wednesday, September 30, 3:45 PM - 5:00 PM

**LowDown ShowDown (Basic)**

**2020 ASHRAE LowDown Showdown**

*Chair: John Bynum, Ph.D., Member, WSP USA, New York, NY*

Taking a page from New York City's groundbreaking new Climate Mobilization Act that requires building owners to reduce their carbon footprint, the 2020 LDSd challenges participants to design a new building that has a low carbon or carbon neutral footprint. This year the model building will be located in New York City. Participating Teams will design a 300,000 sf, 15 story mixed-use building located anywhere in the five boroughs. The building will contain retail space, residential space and a full-service restaurant.

**1. BioZero**

*Ljubomir Jankovic, Ph.D., Member, University of Hertfordshire, Hatfield, United Kingdom*

**2. NetCarbon.IN**

*Archie Parakh, Student Member, CEPT University, Ahmedabad, India*

**3. Zero-Carb Diet**

*Alfred Uzokwe Jr., University College London (UCL), London, United Kingdom*

**4. Carbonbusters**

*Joaquin Font, BR+A, New York, NY*

**5. Parametric Posse Recharged**

*Al Mitchell, Student Member, Illinois Institute of Technology, IL*

**6. Aequitas**

*Elizabeth LeRiche, HGA Architects and Engineers, Minneapolis, MN*

**7. The Near Net Zeros**

*Brian Turner, Clark Nexsen Architecture & Engineering, Virginia Beach, VA*

**8. The Carbon Lighters**

*Alfonso Hernandez, AIA, Member, Gensler, Houston, TX*

**9. C.R.E.A.M. (Carbon Rules Everything Around Me)**

*Jason Lackie, WSP, Tempe, AZ*

**10. Carbon Crusaders**

*Miro Zaroukian, tk1sc, Los Angeles, CA*

5:00 PM - 5:15 PM

**LowDown ShowDown**

**LowDown Showdown LIVE Q&A**

*Room:*

*Chair: John Bynum, Ph.D., Member, WSP USA, New York, NY*

Live question and answer period for participating teams.

5:45 PM - 6:45 PM

**LowDown ShowDown**

**LowDown Showdown Judging (LIVE)**

*Room:*

*Chair: John Bynum, Ph.D., Member, WSP USA, New York, NY*

Finalists answer questions from the competition judges.

**Thursday, October 1**

11:30 AM - 12:45 PM

**Conference Paper Session 11 (Intermediate)**

**Code and Beyond-Code Building Design and Analysis**

*Track: Codes & Standards and Programs*



*Chair: Supriya Goel, Pacific Northwest National Laboratory, United States of America*

This session explores several workflows to simplify and streamline modeling, compliance analysis and reporting process. Presenters discuss strategies for optimal window design for daylighting and thermal performance and a parametric analysis workflow for optimizing building design to meet desired performance levels. Additional topics discussed in this session include an automated workflow for calculating fenestration thermal properties, a simple building calculator which uses pre-simulated results to identify a range of common energy conservation measures and a modeling framework developed using Python which automates building analysis and compliance reporting.

**1. Simple Building Calculator (051)**

*Chitra Nambiar, Associate Member and Reid Hart, P.E., Member, Pacific Northwest National Laboratory, Richland, WA*

**2. Calculating Fenestration System U-Factor, SHGC and VT Using Partially Automated Workflows (052)**

*Sarah Rentfro, P.E., Simpson Gumpertz & Heger Inc., Washington, DC*

**3. Shaping High-rise Towers to Meet BC Energy Step Code (053)**

*Haobo Liu, Andrea Frisque, P.Eng., Associate Member, Jeanie Chan, Bowen Xue and Oscar Valdes, Stantec Consulting Ltd., Vancouver, BC, Canada*

**4. Research on Guidelines for Window Design Strategies in High Performance Office Buildings (054)**

*Qinbo Li, Ph.D., Student Member and Jeff Haberl, Ph.D., BEMP, Fellow ASHRAE, Texas A&M University, College Station, TX*

**5. A Modeling Framework for Engine-Neutral Automation of Building Analysis and Compliance Reporting (055)**

*Eric Niemeyer and Sagar Rao, Member, Affiliated Engineers, Inc., Madison, WI*

11:30 AM - 12:45 PM

**Conference Paper Session 12 (Basic)**

**Systems, Components and Loads Analysis**

*Track: Energy Performance and System Simulation*



*Chair: David Eldridge Jr., P.E., Member, Grumman/Butkus Associates, Evanston, IL*

This session covers eight technical paper submissions on modeling everything from combination space and water heating systems for residential applications; to central plant optimization; to water treatment and water modeling; to the impact of vertical soil temperature profile on shallow bore ground heat exchangers. Also tackled is the use of inverse modeling through support vector machine regression (SVM) and physics-based modeling of a steam distribution system in a historic building. The changing climate data is analyzed and projected out through 2100; and strategies to address increasing energy use from plug and process loads is explored.

**1. Energy Analysis of Steam Distribution System Using a Physics-Based Model: A Campus Building Case Study (056)**

*Behzad Salimian Rizi, Student Member, Akram Syed Ali, Christopher Riley, Brent Stephens, Associate Member and Mohammad Heidarinejad, Ph.D., P.E., Associate Member, Illinois Institute of Technology, Chicago, IL*

**2. Future Meteorological Year Weather Data from IPCC Scenarios (057)**

*Brett Bass<sup>1</sup> and Joshua New, Member<sup>2</sup>, (1)The University of Tennessee, Knoxville, TN, (2)Oak Ridge National Laboratory, Knoxville, TN*

**3. Impact of Vertical Soil Temperature Profile on Performance of Shallow Bore Ground Heat Exchangers (058)(P)**

*Liang Shi, Student Member<sup>1</sup>, Ming Qu, Ph.D., Associate Member<sup>1</sup>, Xiaobing Liu, Ph.D., Member<sup>2</sup> and Mingkan Zhang<sup>2</sup>, (1)Purdue University, West Lafayette, IN, (2)Oak Ridge National Laboratory, Oak Ridge, TN*

**4. Effective Strategies for Reducing Plug Load: Results from a Field Study Conducted at Two of the Largest US Banks (059)**

*Robert W Cox, Ph.D., University of North Carolina, Charlotte, NC*

**5. Study of the Whole Building Energy Use Inverse Modeling Performance through Support Vector Machine Regression (060)(P)**

*Shinwoo Lee and Juan Carlos Baltazar, Texas A&M University, College Station, TX*

**6. Water Treatment Technologies in Whole Building Energy and Water Models (061)(P)**

*Fred Betz, Ph.D., Member and Sarah Balz, Affiliated Engineers, Inc, United States of America*

**7. Central Plant Design Optimization Tool (062)(P)**

*Pouya Rezazadeh Kalehbasti, Ph.D., Student Member and Te Qi, P.E., BEMP, Associate Member, Atelier Ten USA LLC, San Francisco, CA*

11:30 AM - 12:45 PM

## Seminar 6 (Intermediate)

### Optimizing the Connections of Visual and Thermal Comfort

Track: Daylighting and Comfort



Chair: Susan Collins, Whole Building Systems, Charleston, SC

This session explores methods used to analyze visual and thermal comfort of building occupants and their inherent impact on each other. It discusses a novel Internet of Things based control strategy of electrochromic glazing, and a case study validating the benefits of electrochromic technology across multiple building locations and window orientations compared to traditional glazing with shades. Further case studies are presented on a model of a classroom to discuss robust multi-objective optimization techniques for thermal comfort and efficiency. Finally, this session concludes with a comparison of compliance options for meeting daylight exposure requirements of the WELL Building Standard v2.

#### 1. Design, Implementation and Evaluation of IoT Based Control Strategy of Electrochromic Glazing for Visual Comfort and Energy Efficiency

*Qingqing Sun, Ph.D.*

#### 2. Case Study Validation Of Occupant Comfort With Dynamic Glazing

*Galen Burrell<sup>1</sup> and Ranojoy Dutta, BEMP and HBDP, Associate Member<sup>2</sup>, (1)View, Inc, Milpitas, CA, (2)View Inc, Milpitas, CA*

#### 3. Case Study: Fast & Robust Techniques For Optimizing Classroom Occupant Comfort and Thermal Efficiency

*Michael Sawford, Associate Member<sup>1</sup> and Adarsh Elango<sup>2</sup>, (1)EDSL USA, Inc., New York, NY, (2)ESTECO North America Inc., Novi, MI*

#### 4. Predicting Thermal Comfort in Transient and Non-Uniform Environments: A New Web Tool

*Nathaniel L Jones, Ph.D., Associate Member, Arup, Boston, MA*

#### 5. Comparison of Compliance Paths for WELLv2 Precondition L01.1 Ensure Daylight Exposure

*Shana Scheiber, P.E., Member, Affiliated Engineers, Inc, Madison, WI*

11:30 AM - 1:00 PM

### Panel 6 (Intermediate)

### How to Tell Architects Something They'd Rather Not Hear (LIVE)

Track: Energy Performance and System Simulation

Moderator: Alejandra Menchaca

This panel features an architect, an energy analyst, a sustainability consultant, and an in-house building scientist, who will discuss ways to address the challenges of communicating results or updates to results that might be unexpected or unaligned with client or design team expectations. Ultimately, transparency and communication are essential to bettering high-performance design. The panelists provide perspectives on ways to educate clients on the level of uncertainty in the simulation process as the design evolves.

#### 1. How to Tell Architects Something They'd Rather Not Hear

*Alejandra Menchaca, Craig Simmons, P.E., BEMP<sup>2</sup>, Aman Singhvi<sup>3</sup> and Kjell Anderson, AIA<sup>4</sup>, (1)VEIC, Burlington, VT, (2)AECOM, New York, NY, (3)LMN Architects, Seattle, WA*

Thursday, October 1, 1:00 PM - 2:15 PM

### Panel 7 (Intermediate)

### Modeling Occupant Behavior in Buildings (LIVE)

Track: Occupant Behavior

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

Occupant behavior is a significant factor influencing energy use and occupant comfort in buildings. This session covers the cutting-edge research of modeling occupant behaviors in buildings. Four presentations span from modeling the occupant-centric controls and detailed occupant movement and behavior using the whole building simulation program to exploring data-driven modeling of occupant thermal comfort behavior and occupant-centric buildings-to-grid integration.

#### 1. Quantification of HVAC Energy Savings for Occupancy Sensing in Buildings through a Simulation Suite

*Jian Zhang, Ph.D., Member, Pacific Northwest National Laboratory, United States of America*

#### 2. Improving Building Performance Simulation with Detailed Occupant Movement and Behavior Modeling

*Zhe Wang, Ph.D., Associate Member, Lawrence Berkeley National Lab, United States of America*

#### 3. The Limits of Data-Driven Modeling of Occupant Thermal Comfort Behavior Dynamics

*Michael Kane, Ph.D., Member, Northeastern University, United States of America*

#### 4. Occupant-Centric Buildings-to-Grid Integration for Future Smart and Connected Communities

*Bing Dong, Ph.D., Member, Syracuse University, Syracuse, NY*

1:00 PM - 2:15 PM

### Conference Paper Session 13 (Intermediate)

## Modeling Advances in Buildings Controls Analysis

Track: *New Technology and Trends*



Chair: *Carrie Brown, Ph.D., Member, Resource Refocus, LLC, Oakland, CA*

This session explores new modeling technique to enable advanced control design and model-based building control. There are two papers related to EnergyPlus. One introduces Spawn-of-EnergyPlus, which enables both energy modeling and HVAC control modeling. The other develops an EnergyPlus baseline model for occupant-centric control. Three papers explore quick prediction of the building performance using deep learning, grey-box model, and cloud-based simulation for different applications. The last paper compares the performance of different optimization methods for building design and control.

### 1. Lifting the Garage Door on Spawn, an Open-Source BEM-Controls Engine (063)

*Michael Wetter, Ph.D., Member<sup>1</sup>, Kyle Benne<sup>2</sup>, Antoine Gautier<sup>1</sup>, Thierry S. Nouidui<sup>3</sup>, Agnes Ramle<sup>4</sup>, Amir Roth<sup>5</sup>, Hubertus Tummescheit<sup>6</sup>, Stuart Mentzer<sup>7</sup> and Christian Winther<sup>4</sup>, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)National Renewable Energy Laboratory, Golden, CO, (3)Nouidui Consulting, USA, (4)Modelon, Sweden, (5)US Dept. of Energy, (6)Modelon, (7)Objexx, USA*

### 2. Development of Baseline Building Energy Models for the Advanced Occupant-Centric Building Control Research in the Various U.S. Climates (064)

*Zhihong Pang, Student Member<sup>1</sup>, Yan Chen<sup>2</sup>, Jian Zhang, Ph.D., Member<sup>2</sup>, Zheng O'Neill<sup>1</sup> and Yulong Xie, Ph.D.<sup>2</sup>, (1)Texas A&M University, College Station, TX, (2)Pacific Northwest National Laboratory, Richland, WA*

### 3. Towards the Applications of Deep Learning to Generating Desired Design Options: Experiments Using Synthetic Training Dataset (065)(P)

*Zohreh Shaghaghian and Wei Yan, Ph.D., Texas A&M University, College Station, TX*

### 4. Decentralized Approach to Multi-Zone Grey-Box Modeling for Model-Based Predictive Control (066)

*Borui Cui, Jaewan Joe, Piljae Im, Ph.D., Member and Jin Dong, Member, Oak Ridge National Laboratory, United States of America*

### 5. Demand Respond Assessment Tool: A Cloud-Based Simulation Tool for Rapid Assessment of Demand Response Potential in Commercial and Institutional Facilities (067)

*Robert Cox, Ph.D., Benjamin Futrell, Madison Wynn and Eric Tate, University of North Carolina, Charlotte, NC*

### 6. Comparing the Performance Of Optimization Methods Used for Building Design and Optimal Control of Building Systems (068)(P)

*Afshin Faramarzi, Student Member<sup>1</sup>, Parastoo Delgoshaei<sup>2</sup>, Brent Stephens, Associate Member<sup>1</sup> and Mohammad Heidarinejad, Ph.D., P.E., Associate Member<sup>1</sup>, (1)Illinois Institute of Technology, Chicago, IL, (2)National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA*

1:00 PM - 2:15 PM

### Conference Paper Session 14 (Intermediate)

## Occupant Comfort at an Urban Scale and CFD

Track: *Health, Wellness and Comfort*



Chair: *Susan Collins, Whole Building Systems, Charleston, SC*

This session presents a deep dive into urban scale modeling, outdoor comfort, and computational fluid dynamics (CFD). The session includes a literature review of outdoor thermal comfort studies, in addition to a novel study evaluating comfort level of citizens using reviews gathered from Google Maps. The session also introduces a new cloud-based 'Pedestrian Comfort Analysis' application and a climate building interaction framework to assess the influence of local micro-climates. Finally, the session includes CFD used at a smaller scale, to optimize the exact placement of building elements and mechanical configurations.

### 1. Occupants' Comfort At Urban Scale- Analyzing Citizens' Opining Using Convolutional Neural Networks (069)

*Farzaneh Zarei and Mazdak Nik-Bakht, Concordia University, Montreal, QC, Canada*

### 2. Investigation of the Potential Benefits of Optimizing Building Element Placement using Computational Fluid Dynamics (070)

*Nastaran Shahmansouri, Ph.D.<sup>1</sup>, Rhys Goldstein<sup>1</sup>, Farhad Javid<sup>1</sup>, Alexander Tessier<sup>1</sup>, Simon Breslav<sup>1</sup> and Azam Khan<sup>2</sup>, (1)Autodesk Research, Toronto, Canada, (2)Department of Computer Science, University of Toronto, Toronto, Canada*

### 3. CFD-BES-BIM Integrated Sustainable and Resilient Building Design for Northern Architecture (071)

*Muna Younis, Ph.D., Girma Bitsuamlak and Meseret Kahsay, Western University, London, ON, Canada*

#### **4. Large Scale Modelling Of Wind Comfort and Safety Using ‘Pedestrian Comfort Analysis’: A Cloud-based App Crafted for Architects (072)**

*Sandip Jadhav, Vijay Mali, Praveen Kumar Ramachandran and Chaitanya Rane, Centre for Computational Technologies, India, Pune, India*

#### **5. Outdoor Thermal Comfort (OTC) In Human Interaction Based Studies: An Overview of Review (073)(P)**

*Zahida Khan, Student Member, Rahman Azari and Brent Stephens, Associate Member, Illinois Institute of Technology, Chicago, United States of America*

1:00 PM - 2:15 PM  
**Seminar 7 (Advanced)**

### **Advanced Building Analytics**

*Track: Low Carbon Future*



*Chair: Erik Kolderup, P.E., Member, Kolderup Consulting, San Francisco, CA*

This session covers several advanced building analytics applications. The first presentation introduces the significance of the Semantic Web Technologies for different building science applications. The second compares 30-yr marginal and average GHG forecasts for both mixed-fuel and all-electric office buildings and multifamily buildings. The final presentation discusses factors which affect the carbon intensity of the grid, how to represent grid carbon intensity in an energy model, and present several examples of how these structures would vary by region, energy source mix, and community level energy consumption patterns.

#### **1. Introducing Semantic Models and Reasoning for Building Science Applications**

*Parastoo Delgoshaei, National Institute of Standards and Technology, Gaithersburg, MD*

#### **2. 30-yr GHG Forecasts Using Marginal and Average Emissions**

*Jamy Bacchus, P.E., BEMP, Member<sup>1</sup> and Sedighehsadat Mirianhosseinabadi, Ph.D.<sup>2</sup>, (1)ME Engineers, (2)ME Engineers, Golden, CO*

#### **3. Accurately Modeling Operational Carbon**

*Alex Lowrie and Miles Grubbs, P.E., BEMP, Member, Little Diversified Architectural Consulting, Charlotte, NC*

#### **4. Achieving Performance Targets with Prescriptive Compliance**

*Rahul Athalye, Associate Member, NORESO, San Francisco, CA*

Thursday, October 1, 3:30 PM - 4:45 PM  
**Conference Paper Session 15 (Intermediate)**

### **Passive Building Design and Analysis**

*Track: Energy Performance and System Simulation*



*Chair: Eddy Santosa, CallisonRTKL, Seattle, WA*

This session introduces the use of simulation for passive building design and analysis. Passive design strategies considered in the papers of this session include building shape, natural ventilation, rammed earth as thermal mass, double-skin facades, and the teaching of passive systems in Architectural schools.

#### **1. Building Geometry Impact on Achieving Energy Efficient Office Buildings in Egypt (074)**

*Heba Hatem, DSc and Mai Alaaeldin Karram, Alexandria University, Alexandria, Egypt*

#### **2. Energy Simulation of Naturally Ventilated Building Integrated-Photovoltaics Air-Gap Duct Systems (Presentation only)**

*Arash Zarmehr and Joseph T. Kider Jr., University of Central Florida, Orlando, FL*

#### **3. Evaluation of Rammed Earth Assemblies as Thermal Mass Through Whole-Building Simulation (076)(P)**

*Pragya Gupta<sup>1</sup>, Dana Cupkova<sup>2</sup>, Lola Ben-Alon<sup>2</sup> and Erica Cochran Hameen<sup>2</sup>, (1)Carnegie Mellon University, Seattle, WA, (2)Carnegie Mellon University, Pittsburgh, PA*

#### **4. Education of Passive Systems in the US Architecture Schools: From the Conceptual Level to the Levels of Simulation and Calculation (077)(P)**

*Mehdi Azizkhani, Ph.D., Texas A&M University, College Station, TX*

3:30 PM - 4:45 PM  
**Conference Paper Session 16 (Intermediate)**



## Urban Scale Modeling and Working with Big Data

Track: Low Carbon Future



Chair: Wangda Zuo, University of Colorado Boulder, Boulder, CO

This session introduces research related to urban scale modeling and simulation with different applications. The first paper discusses parametric simulation and GIS for resilient city. The second paper explores big data for domestic heating energy consumption. The third shows how to process and visualize the big simulation data. The fourth and fifth paper show how to leverage the public data to assist urban scale energy modeling with one on tax assessor data and the other on building permits data.

### 1. Using Parametric Simulation and GIS to Design a Stormwater Solution for a Chinese Sponge City (079)

Patrick Keeney, AIA, Christopher Drew and Xi Yi, Adrian Smith + Gordon Gill Architecture, Chicago, IL

### 2. Data-Driven Local Area Energy Framework for Modelling Domestic Heat Electrification (080)

Joey Aoun and Carlos Calderon, Ph.D., Newcastle University, Newcastle Upon Tyne, United Kingdom

### 3. Large Scale Post-Simulation Data Processing and Visualization (081)

Junru Shen, Jeanie Chan and Andrea Frisque, P.Eng., Associate Member, Stantec, Vancouver, BC, Canada

### 4. Urban-scale Energy Modeling: Scaling Beyond Tax Assessor Data (082)

Joshua New, Member<sup>1</sup>, Mark Adams, Member<sup>2</sup>, Eric Garrison<sup>3</sup>, Brett Bass<sup>3</sup> and Tianjing Guo<sup>2</sup>, (1)Oak Ridge National Laboratory, Knoxville, TN, (2)Oak Ridge National Laboratory, Oak Ridge, TN, (3)The University of Tennessee, Knoxville, TN

### 5. Extract Useful Information from Building Permits Data to Profile a City's Building Retrofit History (083)

Wanni Zhang, Tianzhen Hong, Ph.D., Member and Xuan Luo, Lawrence Berkeley National Laboratory, Berkeley, CA

3:30 PM - 4:45 PM

## Seminar 8 (Intermediate)

## Reorienting to Orientation

Track: Energy Performance and System Simulation



Chair: Kapil Upadhyaya, Kirksey Architecture, Houston, TX

Many architectural texts refer to building-orientation as one of the first few decisions that impacts performance of buildings. Yet many 'wrongly oriented' buildings rank high when compared using standard compliance methods. To reconcile this discrepancy, a research study was conducted using different building profiles. This seminar summarizes results of that study.

### 1. Reorienting to Orientation

Kapil Upadhyaya, BEMP<sup>1</sup> and Shahryar Habibi<sup>2</sup>, (1)Kirksey Architecture, Houston, TX, (2)Independent Consultant

3:30 PM - 4:45 PM

## Seminar 9 (Intermediate)

## Workflow and Tool Developments

Track: New Technology and Trends



Chair: Krishnan Gowri, Ph.D., Fellow ASHRAE, Intertek, TACOMA, WA

This session addresses workflow and tool developments related to several different elements of building design and operations. The first presentation focuses on a regenerative design workflow for rapidly and efficiently exploring the full design space using BEM during early design phases. The second presentation covers a new capability and methodology for sharing of energy audit information. The third presenter explores the modelling of zero energy mixed-use buildings and the related design guide from ASHRAE. The fourth presenter outlines a methodology for co-simulation of attics for commercial and non-commercial buildings and the last presentation covers Version Control Systems.

### 1. Challenges in Developing a Building Energy Modelling Workflow Using Generative Design Concepts

Francisco Contreras, P.Eng., HHAngus Consulting Engineers, Toronto, ON, Canada

### 2. Representation and Exchange of Audit Template Data using BuildingSync

Mark Ian Borkum, Ph.D., Richard A Fowler and W David Millard, Pacific Northwest National Laboratory, Richland, WA

### 3. Integrating Residential and Commercial Modeling for Zero Energy Mixed-Use Multifamily Building Design

Matthew Dahlhausen<sup>1</sup> and David Goldwasser<sup>2</sup>, (1)National Renewable Energy Laboratory, Golden, CO, (2)NREL

### 4. High Fidelity Data Surrogates for Enhancing Co-Simulation Capabilities of Energy Simulation Tools

Himanshu Sharma, Ph.D.

**5. Version Control System for Modelers**

*Alex Nathan Chapin, P.E., BEMP, Associate Member, Mason and Hanger, Glen Allen, VA*