



2023 Building Performance Analysis Conference

September 11-13, 2023 | Austin, Texas



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



Approved for GBCI LEED AP CE Credits

Monday, September 11

Monday, September 11, 8:10 AM - 9:00 AM

Keynote (Intermediate)

Jason DeGraw

Extreme Events and the Role of Modeling in a Resilient Future

Room: Texas 1-3 (2nd floor)

Computer models are the one tool that offer access to a near limitless variety of scenarios and can deliver results in a timely manner, but current tools are limited and cannot always represent the scenarios that are needed to truly work toward a resilient future. The talk will present an overview of extreme events and how these events relate to the built environment. The related concepts of return to functionality and passive survivability will be presented in the context of modeling. Finally, the relationship between practical building-level resilience and modeling will be discussed, with emphasis on avoiding failures in imagination.

Monday, September 11, 9:10 AM - 10:10 AM

Debate (Basic)

ASHRAE's Corner Debate

Room: Hill Country C-D (1st floor)

Chair: Aaron Patrick Boranian, Senior Energy Engineer, Associate¹, Matthew Duffy, Business Development Manager², Benjamin Brannon³, Patrick Pease, PE, Full Member⁴, Amir Rezaei-Bazkiaei, Ph.D., Associate⁵, Emir Aykut Pekdemir, Associate Member⁶ and Neal J Kruijs, Associate¹, (1)Big Ladder Software, Denver, CO(2)IES(3)ARUP(4)cove.tool, Atlanta, GA(5)Cyclone Energy Group, Buffalo, NY(6)Atelier Ten, New York, NY

The evolution of building performance simulation tools started with slide rules for many engineering calculations, progressing to the first “generation” of simulation engines with hourly resolution in the 1970’s, and eventually leading to the plethora of tool options and features available today. And yet, firms and individuals with enough resources and motivation are continually developing their own unique tools in-house. In this debate, we’ll hear experts in the field debate if practitioners currently have all

the building performance simulation tools necessary to holistically analyze the operational energy, embodied carbon, and comfort of their building designs.

9:10 AM - 10:10 AM

Seminar 1 (Intermediate)

Occupant Behavior-Centric Building Design and Operation and Its Effects on Building Energy Usage



Room: Texas 1-3 (2nd floor)

Sponsor: MTG.OBB Occupant Behavior in Buildings, 1.5 Computer Applications

Chair: Stephen B Roth, PE, Full Member, Carmel Software Corp, San Rafael, CA

Occupant behavior (OB) has a significant impact on building energy usage. Building design and operation strategies that take into account occupants' behavior can significantly reduce energy consumption. This seminar presents an overview of occupant behavior-centric building design and operation and its effects on building energy usage. The first speaker will give a high-level overview of various studies being done on building occupant behavior including ASHRAE RP-1815. The second speaker will describe in more detail RP-1815 and how it will improve the occupant behavior workflow between BIM and analysis. The final speaker will discuss occupant-centric metrics for building design and simulation.

1. An Overview of How Occupant Behavior Affects Building Energy Usage

Stephen B Roth, PE, Full Member, Carmel Software Corp, San Rafael, CA

2. More Findings from RP-1815

Jeffrey W. Ouellette, Independent Consultant, Austin, TX

3. Occupant-Centric Design and Operation of Buildings

Zoltan Nagy, Associate, University of Texas at Austin, Austin, TX

9:10 AM - 10:10 AM

Seminar 2 (Intermediate)

Intelligent Building Operations: Efficiencies and Load Management I



Room: Texas 5-6 (2nd floor)

Chair: Susan Collins, Associate, Whole Building Systems, Mt Pleasant, SC

Faults, controls, and metadata oh my! This session begins with imposing three fault scenarios in a test building to analyze the effects on the cooling system of the rooftop unit and building interior conditions. It continues with a study that combines Artificial Neural Networks (ANN) models that use indoor and outdoor conditions to predict room air temperature and A/C electricity consumption for real-time Model Predictive Control to optimize control variables to reduce cooling energy and deviation from setpoint. This session concludes with the advantages of semantic graphs for visualizing data connections across diverse sources (sensor data, control information, etc.).

1. Impact of Faults on Cooling System of Commercial Building Based on Fault Scenario Testing

Sungkyun Jung, Ph.D., Yeobeom Yoon, Associate and Piljae Im, Ph.D., Full Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Real-Time Implementation of Federated Control for Package Air Conditioners in Residential Buildings

Seongkwon Cho, Jin-Hong Kim and Cheol-Soo Park, PhD, Member, Seoul National University, Suwon City 441-744, South Korea

3. Semantic Metadata: Enabling Analytics Applications with Intelligent Data Management

Parastoo Delgoushaei, Associate¹ and Mohammad Heidarinejad, Ph.D., P.E., S-B-a Member², (1)NIST, Gaithersburg, MD, (2)Illinois Institute of Technology, Chicago, IL

9:10 AM - 10:10 AM
Seminar 3 (Advanced)

Thermal and Hygrothermal (envelope) Modeling I



Room: Hill Country A-B (1st floor)

Chair: Ranojoy Dutta, BEMP, Associate, View Inc, SAN JOSE, CA

Building science analysis is one of the most sustainable practices: helping ensure durability of the building envelope. This session includes a range of thermal and hygrothermal adventures. The first speaker gives a high level overview of hygrothermal analysis, demystifying rules of thumb and advising on key concepts to consider. The second speaker discusses the impact of building science analysis on building enclosure commissioning (BECx). The third speaker reviews a critical input for hygrothermal analysis: the impact of environmental conditions, specifically focusing on historic and future weather. Each speaker includes case studies to relate concepts to practice.

1. Adventures in Hygrothermal Modeling

Keith Aaron Simon, FAIA, BCxP, Terracon, Austin, TX

2. Role of Thermal and Moisture Performance Analysis in Building Enclosure Commissioning

Krishnan Gowri, PhD, Fellow Member, Intertek Inc., Bothell, WA

3. Comparing Historic and Future Weather for Envelope Hygrothermal Analysis

Daniel Chung, Full Member, University of Toronto, Toronto, ON, Canada

Monday, September 11, 10:30 AM - 12:00 PM
Panel 1 (Basic)

Solution Room

Room: Texas 1-3 (2nd floor)

Chair: Aaron Patrick Boranian, Senior Energy Engineer, Associate, Big Ladder Software, Denver, CO

This session presents attendees with an opportunity to interact with their peers and "crowd source" answers to their burning questions. This is the same intent as unmethours.com -- a question-answer forum for building energy simulations -- but offered in a live, interactive, and dynamic format for conference attendees. Participants are given time to think of a challenge they are facing before presenting their problem to a group for brainstorming. 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?

10:30 AM - 12:00 PM
Seminar 5 (Intermediate)

Modeling Advances: Tools and Workflows I



Room: Texas 5-6 (2nd floor)

Chair: Ranojoy Dutta, BEMP, Associate, View Inc, SAN JOSE, CA

This session covers tool and workflow advances related to holistic analysis for lighting and daylight to energy model prototypes and standards. The first presentation focuses on a workflow for linking energy and non-energy metrics to model lighting control. The session then moves to a review of energy prototypes and best practices in developing a good prototype. Then, a deep dive into ASHRAE Standard 205-2023 Representation of Performance Data For HVAC&R and Other Facility Equipment covers additions and changes to the standard this year. Finally, the session concludes with a session on a parametric multi-objective performance analysis for facade optimization.

1. A Workflow for Modeling Integrated Lighting Control Based on Energy and Non-Energy Performance Metrics

Tammie Yu¹ and Taoning Wang², (1)Lawrence Berkeley National Laboratory, (2)Lawrence Berkeley National Lab, Berkeley, CA

2. An Update on ASHRAE Standard 205-2023

Charles S Barnaby, Fellow Life Member¹ and Neal J Kruis, Associate², (1)CSB Consulting, Moultonborough, NH, (2)Big Ladder Software, Denver, CO

3. Multi-Objective Performance Analytics: Daylight and Energy to Inform the Ultimate Enclosure

Jake Chevrier and Reinhardt Swart, LC, SmithGroup, San Francisco, CA

10:30 AM - 12:00 PM
Seminar 6 (Intermediate)

Lighting



Room: Hill Country A-B (1st floor)

Chair: Nicole Peterson, Associate, Thornton Tomasetti, Portland, ME

This session addresses modeling of building lighting systems. The first presentation describes design and configuration of a grid-responsive lighting system. The second deals with use of photometry and physics-based rendering to generate realistic lighting scenes under a range of realistic sky conditions. The third presents developments in daylight modeling tools and workflows, with a focus on complex fenestration systems, visual and non-visual radiation, and the packaging of these into tool libraries. The fourth presents a method for extracting similarity features from luminance maps and using this information to infer occupant visual preferences in daylight spaces using deep learning-based classification models.

1. Commissioning and Demonstration of a Residential Lighting System That Can Respond to Openadr Signals

Shat Pratoomratana and Michael E Poplawski, Associate, Pacific Northwest National Laboratory, Portland, OR

2. Indoor Photometry and Scene Reconstruction

Guanzhou Ji, Carnegie Mellon University, Pittsburgh, PA

3. Input Data and Tools for Daylight and Control Modeling

Taoning Wang, Lawrence Berkeley National Lab, Berkeley, CA

4. Inferring Personal Lighting Preferences Using HDR Imaging and Deep Learning Techniques

Dongjun Mah, Student¹ and Athanasios Tzempelikos, PhD, Full Member², (1)Purdue University, (2)Purdue University - Civil Engineering, West Lafayette, IN

10:30 AM - 12:00 PM
Seminar 7 (Intermediate)

Modeling for Carbon and Embodied Energy I



Room: Hill Country C-D (1st floor)

Chair: Sedighehsadat Mirianhosseinabadi, Ph.D., Associate, ME-Engineers, Eureka, MO

This session covers important aspects related to building and construction decarbonization. The first presentation emphasizes the need to strike a balance between HVAC system resilience and decarbonization. The second presentation shares results from a modeling framework to quantify material demand and embodied carbon emissions in building construction through mid-century. The third presentation proposes a methodology for mechanical firms to conduct LCA analysis for HVAC systems, with a focus on meeting the MEP 2040 target. The fourth presentation introduces an innovative modular building system based on cross-laminated timber that is carbon-negative cradle-to-grave for single-family homes.

1. Parameters and Metrics for Balancing HVAC Equipment Resilience and Decarbonization

Akshay Vilas Padwal, EIT, Associate¹, Patrick Pease, PE, Full Member² and Mostafa Tahmasebi, Associate Member², (1)Cove Tool, Inc., Atlanta, GA, (2)cove.tool, Atlanta, GA

2. A Detailed Model to Assess Concrete Demand and Its Embodied Carbon in Building Construction: A Case Study of Single-Family Homes in California

Aven P Satre-Meloy, PhD and Kaiyu Sun, Member, Lawrence Berkeley National Lab, Berkeley, CA

3. Towards Meeting the MEP 2040 Challenge: A Methodology for Conducting Life Cycle Assessment Analysis of HVAC Systems

John Williams¹, Amulya Surapaneni, Associate¹, Kathryn A Lee, P.E., Full Member² and Cynthia Jocelyne Sandoval, Student¹, (1)Harris Design Studio, Oakland, CA, (2)Harris, Oakland, CA

4. The Circular Home: A Negative-Carbon Modular Residence Designed for Iterative Disassembly and Reuse

Kieren McCord, Ph.D., Associate¹, Chrissi Antonopoulos, Associate² and Patricia Gunderson¹, (1)Pacific Northwest National Laboratory, Richland, WA, (2)Pacific NW National Laboratory, Richland, WA

Monday, September 11, 1:40 PM - 3:10 PM
Seminar 8 (Intermediate)

Energy Equality, Access and Justice



Room: Texas 5-6 (2nd floor)

Chair: Walter T Grondzik, P.E., Fellow Life Member, Freelance Consultant, Tallahassee, FL

Extreme heat and other effects of climate change appear to disproportionately affect lower income and traditionally underserved communities in large cities. This session covers four studies that look at various approaches to address energy savings and comfort through evaluating Cooling ECMs, a case study of retrofits using passive and low energy measures, the impact and challenges of electrification and increased grid demand, and how inconsistent and poorly implemented energy code compliance could exacerbate an already challenging situation for at risk populations.

1. Extreme Weather Impact Analysis of Cooling Access Measures Offered by Los Angeles Department of Water and Power Incentive Program through Cool Los Angeles Initiative

Babak Yazdanpanah, Associate and Sean Lim, Los Angeles Department of Water and Power, Los Angeles, CA

2. Building Electrification: A Holistic Analysis of Its Environmental, Economic and Housing Affordability Impacts through Life Cycle and Grid-Response Assessments

Matthew RT Williams, PhD Candidate, Student¹, Michael Reynolds¹, Chris Parker², Jianli Chen¹ and Kody Powell¹, (1)University of Utah, Salt Lake City, UT, (2)Giv Group

3. Pathway to Improve Resilience and Energy Performance for Multi-Family Buildings in Disadvantaged Community in Los Angeles County

Sang Hoon Lee, Ph.D. and Tianzhen Hong, PE, Fellow Member, Lawrence Berkeley National Laboratory, Berkeley, CA

4. Equity in Energy Code Compliance

Harshil Nagda¹, Chitra Nambiar, Associate¹, Yulong Xie, Ph.D., Associate² and HariPriya Sathyanarayanan¹, (1)Pacific Northwest National Laboratory, Millbrae, CA, (2)Pacific Northwest National Laboratory, Richland, WA

1:40 PM - 3:10 PM
Seminar 9 (Intermediate)

Modeling Existing Buildings I



Room: Hill Country A-B (1st floor)

Chair: John D Bynum, PhD, Arup Ireland

Modelling and assessment of existing buildings represents a significant challenge to reducing energy consumption and carbon emissions but is essential to meeting national and international reduction targets. This session presents several workflows and tools designed to aid different stakeholders in reducing energy consumption and carbon emissions including a workflow for existing building calibrated modelling at scale, a tool for rapid assessment of US schools covering energy, health & wellbeing and safety measures/actions and a machine learning technique for Scope 1 & 2 decarbonization. The final session presents a summary of CBECs 2018 with some takeaways from the data.

1. Generating Energy Models of Existing Buildings Using Open Data

Amanda O'Donnell¹ and Duncan Prael, Full Member², (1)CUNY Building Performance Lab, New York, NY, (2)CUNY Building Performance Lab, New York, NY

2. Quick Building Assessment Tool

Juan Gonzalez, Pacific Northwest National Lab, Richland, WA

3. Highlights from the 2018 Commercial Buildings Energy Consumption Survey

Jay Olsen¹, Tuncay Alparslan¹, Joelle Davis Michaels², Stacy Angel¹ and Zachary Marohl¹, (1)U.S. Energy Information Administration, (2)Energy Information Administration, Alexandria, VA

4. Adopting Improved Energy Efficiency Metrics for Commercial Building Energy Performance with Ramifications in the Decarbonization of Scope 1 and 2 Emissions

Aditya Ramnarayan, Graduate Research Assistant, Student, Andres Sarmiento, Armin Gerami and Michael Ohadi, University of Maryland, College Park, MD

1:40 PM - 3:10 PM
Seminar 10 (Advanced)

Thermal and Hygrothermal (envelope) Modeling II



Room: Hill Country C-D (1st floor)

Chair: Susan Collins, Associate, Whole Building Systems, Mt Pleasant, SC

This session covers a range of thermal and hygrothermal considerations ranging from modeling to the field, from asking the right questions to innovative technology and procedures. First, it explores predicting the performance of existing envelopes through non-destructive field measurements. The second speaker reviews lessons learned of building science analysis, with a focus on model inputs and assumptions and asking the right questions early. The third speaker provides a case study on thermoelectric systems for heating and cooling. Lastly, the session concludes with a methodology to automate the very time-intensive efforts of thermal bridging takeoffs.

1. Validating Thermal Performance of Existing Wall Assemblies Using in-Field Measurements

Shibei Huang, RWDI, Philadelphia, PA

2. Building Enclosure Modeling Lessons Learned

Cheryl M Saldanha, P.E.¹ and Abigail Sefah, P.E.², (1)Simpson Gumpertz & Heger, New York, NY, (2)Simpson Gumpertz & Heger, Boston, MA

3. Intelligent Facades: Integration of Thermoelectric Materials into Building Facades for Localized Heating and Cooling

Mahsa Farid Mohajer, Ph.D., Sustainable Building Analyst, Associate, Stantec Inc., Seattle, WA

4. Automating Thermal Bridging Take-Offs Using Energy Model Geometry

Taylor RH Dingwall, Affiliate and Mark McVan, BEMP, Associate, MCW Consultants Ltd, Toronto, ON, Canada

1:40 PM - 3:10 PM
Seminar 11 (Advanced)

Empirical Validation of Building Energy Simulation: Unlocking Opportunities in Energy Efficiency



Room: Texas 1-3 (2nd floor)

Sponsor: 4.7 Energy Calculations, SSPC140

Chair: Piljae Im, Ph.D., Full Member, Oak Ridge National Laboratory, Oak Ridge, TN

Recently, efforts have been made to provide reliable empirical data for ANSI/ASHRAE Standard 140, Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs, to enable improved accuracy of building energy model (BEM) engines and improved characterization of their accuracy. This seminar will present the progress and results of the multinational lab efforts to empirically validate the whole building energy models based on the high-quality dataset from full scale test buildings. The buildings includes both residential and commercial buildings, and the validation has been done in whole building energy use, end use, and indoor environmental data.

1. ETNA Empirical Validation Test Specification Development

Joel Neymark, P.E., Full Member, J. Neymark & Associates, Golden, CO

2. ETNA Empirical Validation Test: Uncertainty Analysis

Ji Hyun Kim, Ph.D., BEMP, Associate, Argonne National Lab, Lemont, IL

3. NREL Empirical Validation Test Specification Development

Matthew M Leach, Full Member, NREL, Golden, CO

4. Empirical Validation Test Specification Development: ORNL's Flexible Research Platform (FRP) and NIST's Net-Zero Energy Residential Test Facility (NZERTF) Buildings

Sungkyun Jung, Ph.D., Oak Ridge National Laboratory, Oak Ridge, TN

Monday, September 11, 3:30 PM - 5:00 PM

Panel 2 (Basic)

Project StaSIO Competition Winners

Room: Texas 1-3 (2nd floor)

Chair: Alejandra Menchaca, Kritika Kharbanda, Harvard University and Guanzhou Ji, Carnegie Mellon University, Pittsburgh, PA

Project StaSIO (Standard Simulation Inputs and Outputs), an initiative of IBPSA-USA's Research Committee, is a web-based crowd-sourced repository of simulation graphics and case studies organized around the ASHRAE 209 framework. Project StaSIO continues to organize the 2023 Annual Competition for world-wide organizations or individuals, and winners will be announced in the 2023 ASHRAE Building Performance Analysis Conference. This panel session aims to provide a platform for professionals to showcase their high-quality work to building simulation community. The competition winners and judges will be invited to join this panel session and have in-person discussion for the winning projects.

3:30 PM - 5:00 PM

Seminar 12 (Intermediate)

Modeling Advances: Tools and Workflows II



Room: Texas 5-6 (2nd floor)

Chair: Nicole Peterson, Associate, Thornton Tomasetti, Portland, ME

This session includes a demonstration of a Python-EMS-Based Building Simulation Platform that enables co-simulation among multiple buildings to support decision-making, and optimization. Then an educational resource called BEMyclopedia is introduced, which serves as a comprehensive knowledgebase about building energy modeling. A paper on optimizing window performance examines various building design decisions such as site orientation, occupant behavior etc. and its impact on the selection of window solar heat gain coefficient (SHGC). In closing, a single unified coefficient is introduced to explore potential synergies between energy use intensity, daylighting, operational & embodied carbon, and construction cost.

1. Py-Cosim: An Open-Source Python-EMS-Based Energyplus Co-Simulation Platform

Liang Zhang, Assistant Professor, Associate, The University of Arizona, Tucson, AZ

2. Educating the Next Generation of BEM Practitioners

Dimitri S Contoyannis, Full Member, Model Efficiency, Concord, MA

3. Considering an Old Question in a Changing Context: Case Study of Optimizing Window Properties

Holly Samuelson, DDes, RA, Student¹ and Amir Baniassadi, Ph.D., Student², (1)Harvard Graduate School of Design, Cambridge, MA, (2)Harvard University, Cambridge, MA

4. The Coefficient of Awesomeness: An Unified Metric of Building Performance Fitness

Alfonso E Hernandez, AIA LEED BD+C, Gensler, Houston, TX

3:30 PM - 5:00 PM

Seminar 13 (Intermediate)

CFD Applications for Architectural Decision Making



Room: Hill Country A-B (1st floor)

Chair: Krishnan Gowri, PhD, Fellow Member, Intertek Inc., Bothell, WA

This session begins with a validated CFD model simulating reactive species, such as hydrogen peroxide, generated by air cleaners to analyze the impact of air cleaner locations, reactive species concentrations, and air flow rates from cleaners. It discusses SimScale, an example of CFD tools in the cloud commonly used for microclimate studies and DCRES, Dynamic and Climate Responsive Enclosure System that provides occupant comfort, energy, and carbon benefits over passive envelope strategies. This session concludes with a CFD case study establishing more uniform pressure in the ductwork distribution of a new clinical and research laboratory.

1. CFD Modeling for Reactive Species Air Cleaner Applications in a Classroom

Youngbo Won, Dr., Student¹ and William P Bahnfleth, Ph.D., P.E., Presidential Fellow Life SBA Member², (1)The Pennsylvania State University, (2)The Pennsylvania State University, State College, PA

2. Building Performance Analysis in the Cloud: Development of the All-Cloud Software Stack

Mike Dombrowski and Naghman Khan, SimScale GmbH

3. The Ventilation and Thermal Performance of Dynamic and Climate Responsive Enclosure Systems (DCRES)

Zhan Shi, Ph. D. student, Student and Erica Cochran Hameen, Faculty, Carnegie Mellon University, Pittsburgh, PA

4. Optimizing Ductwork Distribution in a Large Clinical Application Using CFD: A Case Study
Saber Khoshdel Nikkho, PE, BEMP, Associate and Mehran Salehi, Associate, Harris Company, Arlington, VA

3:30 PM - 5:00 PM

Seminar 14 (Intermediate)

Modeling for Carbon and Embodied Energy II



Room: Hill Country C-D (1st floor)

Chair: Sedighehsadat Mirianhosseinabadi, Ph.D., Associate, ME-Engineers, Eureka, MO

This session begins with focusing on the importance of thermal energy demand intensity (TEDI) of a building design, what design measures affect TEDI, and how progressive building codes and voluntary standards have included TEDI as a targeted metric. This session continues with two case studies, one achieving net zero energy and carbon for a public cultural arts center outside Chicago, and another achieving net zero carbon for a privately-owned wet biology laboratory building in climate zone 5A. This session concludes with proposing an early-phase modeling framework to assess and compare mechanical and architectural alternatives that yield fully electric laboratories.

1. Energy and Carbon Key Performance Indicators Leading Design (beyond EUI)

Aylin Ozkan, Ph.D., RWDI, Philadelphia, PA

2. Net Zero Retrofit of a Chicago Historic Arts Center

Kate Bren, E.I.T., Affiliate and Vinit Gala, E.I.T. LEED AP BD+C, Cyclone Energy Group, Chicago, IL

3. Case-Study: Optimizing Embodied and Operational Carbon for a Net-Zero Carbon Lab Building Design

Elizabeth LeRiche, Associate and Russell Knudson, pe, BCxP, Associate, HGA, Minneapolis, MN, United States

4. Enabling Decarbonization in Biomedical Research Buildings: Early Design Integrated Modeling for a New Fully Electric Laboratory in Columbia University

Christina Brown, Environmental Performance Specialist¹, Carlos Davila Cerezo, Sustainable Design Director¹, Patrick Krystyniak, BEMP, Associate², Jeff Rios, P.E., BEMP, Member² and Jake P Canale, P.E., Associate², (1)Kohn Pedersen Fox, New York, NY, (2)AKF Group, New York, NY

Tuesday, September 12

Tuesday, September 12, 8:10 AM - 9:00 AM

Keynote (Intermediate)

Duncan Cox

Whole Life Carbon, is This the Right Approach?

Room: Texas 1-3 (2nd floor)

Life Cycle Assessments are being embraced throughout the construction industry, and it's exciting to see the positive impacts these assessments are having on reducing embodied carbon in design and delivery on site. They've typically focused on the upfront embodied carbon associated to structural material choice and design. It's become evident that there's been an underestimation of the carbon emissions associated with the building enclosure, as well as the commonly missing elements such as MEP systems and internal building architecture. Duncan presents a whole life carbon approach to consider both embodied and operational carbon during the early stage of design.

Tuesday, September 12, 9:10 AM - 10:10 AM

Panel 3 (Intermediate)

Making the Most of Modeling

Room: Texas 1-3 (2nd floor)

Chair: Ante Vulin¹, Michael J Adams¹, Ivan A Jose, Associate² and Nathan Kegel, Associate Member³, (1)Glumac, Portland, OR(2)McKinstry, Seattle, WA(3)DLR Group, Cleveland, OH

The sustainable design community is increasingly aware of the environmental impacts of energy time of use, grid energy composition, embodied carbon and refrigerant. At the same time, energy modelers are most commonly engaged for a limited set of services, especially energy code compliance and LEED documentation, that may not consider these factors at all. In this

moderated panel, professional practitioners will share how conventional scopes can still yield meaningful performance improvements in buildings. A variety of tools, resources and approaches will be shared.

9:10 AM - 10:10 AM

Seminar 15 (Intermediate)

Intelligent Building Operations: Efficiencies and Load Management II



Room: Texas 5-6 (2nd floor)

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

This session begins with a study investigating the heating and cooling energy savings from installing automated interior insulating shades with four different control algorithms in a Chicago high-rise office building. This session continues with using two prototype residential building models in Orlando, FL, and Indianapolis, IN to investigate the impact of refrigerant charge faults on building indoor conditions and HVAC system operation under different thermostat setpoint temperatures. This session concludes with leveraging building management system data for medical office buildings to compare modeled cooling loads to actual loads, including additional data sources to provide a more accurate comparison.

1. Energy End-Use Analysis on the Novel Automated Interior Insulating Window Shades in a High-Rise Office Building

Jongki Lee, Student¹ and **Mohammad Heidarinejad, Ph.D., P.E., S-B-a Member²**, (1)Illinois institute of technology, Chicago, IL, (2)Illinois institute of Technology, Chicago, IL

2. Impact of Refrigerant Charge Faults on Building Indoor and System Operation Under the Different Indoor Air Set-Point Temperature Settings

Yeobeom Yoon, Associate¹, **Jon Winkler²**, **Piljae Im, Ph.D., Full Member¹** and **Jeffrey D Munk²**, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)National Renewable Energy Laboratory, Golden, CO

3. Leveraging 300 Million Data Points to Enhance Energy Efficiency in Medical Office Buildings

Harshana Thimmanna, BEMP¹ and **Peter McNally²**, (1)Smithgroup, San Francisco, CA, (2)Smithgroup, Ann Arbor, MI

9:10 AM - 10:10 AM

Seminar 16 (Intermediate)

Occupant Health, Wellbeing and Comfort



Room: Hill Country A-B (1st floor)

Chair: Walter T Grondzik, P.E., Fellow Life Member, Freelance Consultant, Tallahassee, FL

Three presentations engage occupant comfort in indoor and outdoor settings and from the thermal and visual perspectives. The first presentation uses case studies to give an overview of city-scale outdoor microclimate simulations and their practical use in urban planning. The second addresses occupant seating choices as influenced by user perceptions of visual environmental quality. The third assesses the ability of personal micro-zonal thermal controls to improve occupant experiences and energy efficiency.

1. Regulating Comfort: The City of London Thermal Comfort Guidelines and Beyond

Ryan Danks, P.Eng., RWDI, Toronto, ON, Canada

2. The Interactive Relationship of Visual Environments and Mobility within Workplace

JeEun Lee, Student and **Ying Hua, Ph.D., Cornell University, Ithaca, NY**

Tuesday, September 12, 10:30 AM - 12:00 PM

Seminar 4 (Intermediate)

Recent and Planned Additions to ASHRAE Standard 140, Method of Test For Evaluating Building Performance Simulation Software



Room: Texas 1-3 (2nd floor)

Sponsor: SSPC 140

Chair: Joel Neymark, P.E., Full Member, J. Neymark & Associates, Golden, CO

ASHRAE Standard 140 has some exciting recent additions and developments in progress. In this seminar, presenters will discuss the recently published addendum that provides acceptance criteria (i.e. a pass-fail criteria); the Whole Building Modeling test suite in development; and a roadmap for other planned new additions including reorganization of current Standard 140 content to facilitate usability and integrating new material, a users manual, reporting automation, and more test suites.

1. ASHRAE Standard 140 Roadmap

Timothy P McDowell, Full Member, Thermal Energy Systems Specialists, Madison, WI

2. ASHRAE Standard 140 Acceptance Criteria

Jason John Glazer, P.E., BEMP, Full Member, GARD Analytics, Lino Lakes, MN

3. Statistical Basis of ASHRAE Standard 140 Acceptance Criteria

Ralph T Muehleisen, Ph.D., P.E., Full Member, Argonne National Laboratory, Lemont, IL

4. Compliance Modeling Tests for ASHRAE Standard 140

Yan Chen, Ph.D., Full Member, Pacific Northwest National Laboratory, Portland, OR

10:30 AM - 12:00 PM

Seminar 17 (Intermediate)

Modeling Advances: Tools and Workflows III



Room: Texas 5-6 (2nd floor)

Chair: Ranojoy Dutta, BEMP, Associate, View Inc, SAN JOSE, CA

This session begins with a generic framework for data-driven building energy flexibility quantification which considers different levels of data availability and use cases. A unified set of prototype models are presented to represent California's building stock and provide the agencies with a single set of prototypes for conducting their analysis. The following research project aims to develop a simulation-based approach for modeling the impact of crowded occupancy on building energy performance and indoor comfort. In the final presentation, the residential BEM landscape is explored, the HPXML/OpenStudio workflow and its software architecture and benefits accrued to DOE and industry are highlighted.

1. Data-Driven Modeling and Simulation for Building Energy Flexibility Quantification

Han Li, Associate¹ and Tianzhen Hong, PE, Fellow Member², (1)Lawrence Berkeley National Lab, Berkeley, CA, (2)LBNL, Berkeley, CA

2. Developing Single Family Prototype Models for California

Mohammad Dabbagh, Building Performance Engineer, CHD, Student¹, Rahul Athalye, Director of Codes and Standards¹, Andres Fergadiotti, Engineer, PE, Member² and Bryan Boyce, Associate Director, Member³, (1)NORESCO, Boulder, CO, (2)Southern California Edison, CA, (3)Energy Solutions

3. Modeling the Impact of High Occupancy on Energy Performance, Indoor Comfort and Moisture Issues in Apartments: Producing Load Profiles for Realistic Simulations

Akram Abdul Hamid, Eng, Student, Lund University, Faculty of Engineering, Department of Building and Environmental Technology, Division of Building Physics, Lund, Sweden

4. How Hpxml/Openstudio Accelerated Energyplus into the Residential Buildings Market

Scott Horowitz, Full Member, Dave Roberts, Noel Merket, Joe Robertson, Yueyue Zhou and Ben Park, Associate, NREL

10:30 AM - 12:00 PM

Seminar 18 (Intermediate)

Modeling Existing Buildings II



Room: Hill Country A-B (1st floor)

Chair: John D Bynum, PhD, Arup Ireland

Building upon the earlier session of a similar title, this session presents three different tools and methodologies for analysing existing buildings and one detailed international adaptive reuse case study. First, this session presents two Department of Energy tools for rapidly assessing building performance and potential improvement opportunities, a semi-automated autocalibration methodology for building energy models to assist with energy efficiency upgrades and a new method of grouping buildings based on their microclimates instead of their climate zone. The final presentation outlines a detailed case study of adaptive reuse of a distillery in Sweden including energy and hygrothermal modelling.

1. Better Together

Alex Chapin, PE, BEMP, Associate, NREL, Lakewood, CO, United States

2. Adaptive Reuse of an Old Distillery in Southern Sweden

Emil Palmenas, Student and Edvin Ottosson, Student, Lunds University, Lund, Sweden

3. Enertune: Automated Calibration Tool for Building Energy Models

Ladan Ghobad, Ph.D., Associate¹, Peng Yin, Ph.D.², Ebuka Osunwoke² and Yihong He¹, (1)ENERlite Consulting, Sacramento, CA, (2)University of Louisiana, Lafayette, LA

Tuesday, September 12, 1:30 PM - 3:30 PM
LowDown ShowDown 1 (Basic)

ASHRAE LowDown Showdown

Room: Texas 1-3 (2nd floor)

Chair: Walter T Grondzik, P.E., Fellow Life Member, Freelance Consultant, Tallahassee, FL

This year's selection for the model building is an existing building – the one and only Houston Astrodome! The Astrodome, built in 1965 served as a sports arena for over three decades until the early 2000's. It now sits in disrepair, despite multiple attempts to repurpose the building over the last 20 years. Teams are asked to envision a new creative reuse of the Astrodome to provide needed urban amenities and to do so within the constraints of reduced fossil fuel use and reduced carbon emissions to bring meaningful activities and/or services to downtown Houston.

- 1. Carbon Lighters**
- 2. CO2 Crew**

Tuesday, September 12, 4:00 PM - 5:00 PM
Panel 4 (Basic)

Fish Bowl

Room: Texas 1-3 (2nd floor)

Chair: John D Bynum, PhD, Arup Ireland

A fishbowl panel discussion comes from a popular open fishbowl conversation format. Members of the audience sit on stage or in the center of the room to discuss a topic introduced by the panel moderator. At any time, any member of the audience can join the fishbowl panel by replacing an existing participant. The discussion continues with participants frequently entering and leaving the panel until the time is up. The moderator then summarizes the discussion.

Wednesday, September 13

Wednesday, September 13, 8:10 AM - 9:00 AM
Keynote (Intermediate)

Alejandra Menchaca

Early Design: The Greatest Opportunity to Influence Performance

Room: Texas 1-3 (2nd floor)

Wednesday, September 13, 9:10 AM - 10:10 AM
Seminar 19 (Intermediate)

Infusion of Building Energy Modeling and Modeling Tools in an Architectural Engineering Program



Room: Texas 1-3 (2nd floor)

Chair: Mohammad Heidarinejad, Ph.D., P.E., S-B-a Member, Illinois institute of Technology, Chicago, IL

This session aims at summarizing different teaching tools and approaches implemented in the Architectural Engineering program at the Illinois Institute of Technology to teach building energy modeling in order to educate the next generation of the architectural engineers. The session starts first with introducing the courses that are part of this program and then speakers will provide insights about how OpenStudio, EnergyPlus, Revit software tools are included as part of the competency goals. The courses presented in this session are part of the U.S. Department of Energy (DOE) project to develop building engineering curricula between several institutions.

1. An Overview of Developing Educational Building Energy Modeling and Modeling Tools Resources

Mohammad Heidarinejad, Ph.D., P.E., S-B-a Member, Illinois institute of Technology, Chicago, IL

2. Experiential Building Energy Modeling Learning with Openstudio Application

Jongki Lee, Student, Illinois institute of technology, Chicago, IL

3. Improving Building Energy Modeling and Building Information Modeling Using Ladybug and Revit Tools

Alexander Mitchell, Associate, Illinois Institute of Technology, Chicago, IL

9:10 AM - 10:10 AM

Seminar 20 (Intermediate)

Urban and Community Scale Modeling



Room: Texas 5-6 (2nd floor)

Chair: Susan Collins, Associate, Whole Building Systems, Mt Pleasant, SC

Population increases and migration to urban areas is a future reality. While some cities have instituted regulations and are obtaining and analyzing data, there is still much work to be done. This session examines existing analysis methods for urban scale building energy modeling (UBEM), approaches for predictive modeling of future performance (4D), and also address how the changing nature of climate change itself will impact our ability to deliver on a 2050 goal of decarbonization.

1. Unlocking Operational Energy, Environmental Impacts, and Materials Stocks of Buildings By an Urban Building Energy Model

Rezyan Mohammadizazi¹ and Melissa Bilec², (1)Energy Solutions, Oakland, CA, (2)University of Pittsburgh, Pittsburgh, PA

2. Towards 4D Visualization of Urban Building Environmental Performance: Analysis of Energy and Water Use Performance of Municipal Buildings in Pittsburgh

Kushagra Varma, Doctoral fellow, Student Member and Erica Cochran Hameen, Faculty, Carnegie Mellon University, Pittsburgh, PA

3. Future Climate Considerations for Portfolio-Wide Decarbonization Planning

Alexander B Harris, CEM - Certified Energy Manager, Associate and Bryanna Krekeler, HGA, Minneapolis, MN

9:10 AM - 10:10 AM

Seminar 21 (Intermediate)

Intelligent Building Operations: Grid Interactions and Distributed Energy Resources



Room: Hill Country A-B (1st floor)

Chair: Ranojoy Dutta, BEMP, Associate, View Inc, SAN JOSE, CA

This session begins with practical considerations for modeling existing buildings using gray-box and black-box methods to analyze the demand flexibility within buildings to provide grid services (building sector electrification, e.g.). This session continues with a large-scale modeling framework to reduce energy costs across different climates and HVAC system types for single-family homes with roof top photovoltaic panels, battery energy storage systems, and electric vehicle charging. This session concludes with analyzing the bill-saving potential of load shifting technologies by simulating hundreds of thousands of different scenarios for time-of-use electricity tariffs and price-informed battery storage strategies using high-fidelity EnergyPlus commercial building models.

1. Large-Scale Analysis of Single-Family Home Energy Systems with Photovoltaic Panels, Battery Energy Storage, and Electric Vehicle Charging

Cary Faulkner, Student, Pacific Northwest National Laboratory, Boulder, CO

2. How Can Time-of-Use Tariffs Drive Energy Storage Adoption in Buildings: A Large-Scale Simulation-Based Investigation

Xuechen Lei, Ph.D., Associate, Ellen M Franconi, PhD, Full Member, Vrushali Mendon, Associate and Yunyang Ye, Ph.D., Associate, Pacific Northwest National Laboratory, Richland, WA

Wednesday, September 13, 10:30 AM - 12:00 PM

Panel 5 (Intermediate)

Panel on Training & Education

Room: Texas 1-3 (2nd floor)

Chair: Aaron Patrick Boranian, Senior Energy Engineer, Associate, Big Ladder Software, Denver, CO, Mohammad

Heidarinejad, Ph.D., P.E., S-B-a Member, Illinois Institute of Technology, Chicago, IL, Joel Neymark, P.E., Full Member, J.

Neymark & Associates, Golden, CO, Nathan Kegel, Associate Member, DLR Group, Cleveland, OH and Alfonso E Hernandez, AIA LEED BD+C, Gensler, Houston, TX

Building simulation is widely accepted by the AEC industry as a prerequisite for designing high-performance buildings and evaluating efficiency measures. The ability to interpret simulation results and draw meaningful insights is a critical skill for

simulation practitioners but is often hard to acquire without extensive work experience. In addition, whole-building simulation requires multidisciplinary knowledge and poses a steep learning curve for new practitioners who must navigate a vast array of online resources. In this panel, we will hear from experienced simulation practitioners and educators regarding the quality and availability of training for new entrants to the field of building simulation.

10:30 AM - 12:00 PM

Seminar 22 (Intermediate)

Modeling Advances: Tools and Workflows IV



Room: Texas 5-6 (2nd floor)

Chair: *Walter T Grondzik, P.E., Fellow Life Member, Freelance Consultant, Tallahassee, FL*

One of the challenges modeling practitioners face today is being nimble enough to iterate simulations to address the conflicting priorities of the design team, Owner and other stakeholders. This session presents a case study for a large health care facility in its quest for net zero carbon, a case study using co-simulation to integrate data to optimize design and performance evaluation for a commercial office building with VRF, and the development of an open source web interface tool for Open Studio that's designed to be simpler to use by being tailored to a few high frequency applications and analysis types.

1. Modeling with Conceptual Design Uncertainties: Modeling a Large Healthcare Building for Actionable Energy/Thermal Load Results

Amir Rezaei-Bazkiaei, Ph.D., BEMP, Associate¹, Brett Horin² and Conor Rielly², (1)Cyclone Energy Group, Buffalo, NY, (2)CannonDesign, Chicago, IL

2. Implementing Data Schemas to Achieve Energy Model Interoperability Among Disciplines

Brett Horin, Student, CannonDesign, Chicago, IL

3. A Web Application for Running Large-Scale Analyses on Openstudio Server

Jocelyn Lorrey, VEIC, Winooski, VT

10:30 AM - 12:00 PM

Seminar 23 (Intermediate)

Holistic Performance Advances



Room: Hill Country A-B (1st floor)

Chair: *Nicole Peterson, Associate, Thornton Tomasetti, Portland, ME*

This session focuses on thinking holistically, demonstrating frameworks and analyses used for optimization, linking various areas of building performance. The first speaker ties carbon reduction and human comfort to daylight, energy, and community growth with a California-based case study. The second speaker will showcase an all-electric multifamily high-rise in Chicago, demonstrating a range of technologies that worked together to inform decision-making. The third speaker explores balancing comfort and energy through electrochromic glazing and radiant cooling. The fourth speaker presents a simulation-based multi-objective optimization method to select glazing and shading products during early design.

1. Balancing Carbon and Comfort: A Holistic Building Analysis of a Net Zero Carbon Development

Ladan Ghobad, Ph.D., Associate, ENERlite Consulting, Sacramento, CA

2. Design and Simulation of a Large Scale All Electric High-Rise Multifamily Building in Chicago

Weijun Allen Mei, P.E., C.E.M., LEED AP, BEMP, Associate, Cyclone Energy Group, Chicago, IL

3. Exploring Synergies between Electrochromic Glazing and Radiant Cooling for Achieving Comfort and Energy Efficiency

Ranojoy Dutta, BEMP, BEMP and HBDP, Associate, View Inc, SAN JOSE, CA