2021 ASHRAE Building Performance Analysis Conference

November 10th - November 12th, 2021

ON-DEMAND

Seminar (Intermediate)

Thermal Resilience Modeling and Analysis to Inform Building Design and Strategy for Improving Occupant's Health in Buildings

With climate change, extreme weather events have become more frequent and intense. How to design, operate and retrofit our buildings to provide a resilient environment for occupants is an essential topic. The seminar includes four diverse but integrated talks covering methods, tools, data and analysis to characterize and evaluate thermal resilience of occupants in buildings, aiming to inform strategies and policy on climate resilience of the built environment, as well as nexus of building energy efficiency and thermal resilience.

1. CAL-Thrives: A California Toolkit for Heat Resilience in Underserved Environments
***Max Wei, Ph.D.**, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Calculation and Reporting of Resilience Metrics in Energyplus
***Xuan Luo**, LBNL, United States of America, Berkeley, CA*

3. International Energy Agency Annex 80: Resilient Cooling of Buildings
***Ronnen Levinson, Ph.D.**, Lawrence Berkeley National Laboratory, United States of America*

4. Analysis of the Ecobee Smart Thermostat Dataset to Inform Planning of Rolling Power Outages
***Tianzhen Hong, Ph.D., Fellow ASHRAE**, Lawrence Berkeley National Laboratory, Berkeley, CA*

Seminar (Intermediate)

District Energy System Modeling: Methods, Tools and Case Studies

As we move toward thinking of and operating buildings as constituents of larger energy systems, modeling techniques and associated software must adapt. In this seminar we will present the results of a recently completed US Department of Energy-sponsored project concerned with district energy system modeling. This includes development and demonstration of performance of low-order building models, development of a 4th and 5th generation district energy system model, implementation of these models in newly developed URBANopt software, and validation on a portion of the Ohio State campus. Model performance and next steps will then be discussed.

1. Community and District-Scale Energy Modeling Using URBANopt
***Ben Polly**, NREL, Golden, CO*

2. District Energy Modeling Case Study of a Portion of Ohio State Campus
***Amy Allen, P.E., Associate Member**, National Renewable Energy Laboratory, Golden, CO*

3. Low Order Building Model Development for Use in Urban-Based Analyses
***Vahid Ahmadi Kalkhorani, Student Member**, Ohio State University, Columbus, OH*

4. Decarbonization of District Energy System in the United States
***Valentin Gavan, Ph.D., Member**, Engie Lab CRIGEN, Paris, France*

Seminar (Intermediate)

The Pursuit of More Foundational Data: Benchmark Dataset Development and Applications

The dearth of research-grade datasets from real buildings has been a stubborn barrier in the field of building science. It significantly limits our analysis capabilities but broad-scale instrumentation efforts are very resource-intensive. A new, collaborative effort between four National Laboratories and funded by the U.S. DOE seeks to address this need through 1)

collecting, curating, and making publicly available high-resolution data from a small number of buildings that have broad applicability to a variety of high-impact use cases, and 2) developing an end-to-end, extensible framework to design, describe, and archive building data for maximum impact.

1. Data-Driven Strategic Approach to Reducing Energy and Emissions in Buildings
***Harry Bergmann**, U.S. Department of Energy, Washington, DC*

2. Designing Field Data Collection: Mapping Use Cases to Dataset Needs
***Lieko Earle, Ph.D.**, National Renewable Energy Laboratory, Golden, CO*

3. New and Existing Data Collection Efforts
***Piljae Im, Ph.D., Member**, Oak Ridge National Laboratory, Oak Ridge, TN*

4. Metadata Schema and Dataset Representation
***Tianzhen Hong, Ph.D., Fellow ASHRAE**, Lawrence Berkeley National Laboratory, Berkeley, CA*

5. Data Hosting and Management: The Data Portal
***Vikas Chandan, Ph.D.**, Pacific Northwest National Laboratory, Richland, WA*

Seminar (Intermediate)

Climate Resilient Design for Passive House

With climate change resulting in increased heat and precipitation, coastal flooding, sea level rise and other hazardous events, the built environment is experiencing increased vulnerability, damage and disruption. Incorporating climate resilient design not only protects critical project components from current hazards but helps prepare for and adapt to future challenges. This session will review three Passive House case studies that incorporate both passive survivability and climate resilient design solutions. Participants will be shown a framework for identifying opportunities for risk-informed, future-focused resilient and sustainable strategies that maximize co-benefits and future climate adaptation and reduce downtime following a hazardous event.

1. Climate Resilient Design for Passive House
***Julie Pietrzak, P.E.**, Thornton Tomasetti, New York, NY*

2. Climate Resilient Design for Passive House II
***Elsa Mullin**, Thornton Tomasetti, Portland, ME*

Seminar (Intermediate)

Modeling for Energy, Carbon and Cost

New tools for the evaluation and forecasting of building energy consumption, carbon emissions, and costs associated with their mitigation are emerging rapidly. This session first presents the Cambium tool, designed by NREL to forecast U.S. electrical sector performance under diverse scenarios, and its integration with EnergyPlus. The second explores new features in PNNL's Commercial Building Energy Asset Score that recommend energy- and carbon-saving retrofits for individual existing buildings.

1. Using the Cambium Database in Conjunction with Existing Building Modeling Tools to Evaluate Future Emissions
***Elaina Present**, **Noel Merket, P.E.**, Scott Horowitz, Eric Wilson and Pieter Gagnon, National Renewable Energy Laboratory, Golden, CO*

2. Approximating Measure Level Carbon Savings with Building Energy Asset Score
***Juan Gonzalez Matamoros** and Sarah Newman, Ph.D., Pacific Northwest National Laboratory, Richland, WA*

Seminar (Intermediate)

Occupant Behavior and Comfort

The first presentation offers a comprehensive overview of how occupant behavior affects indoor environmental quality with a focus on human health, comfort, and performance. The second presentation focuses on a new approach to assess resilience for communities including proposed metrics and methodology.

1. Advancing Human Outcome Analytics in Office Buildings to Build Confidence in Indoor Environmental Quality Investment
***Kevin Keene**, Pacific Northwest National Laboratory, Richland, WA*

2. Occupant Behavior & Comfort
***Erica McBride**[1] and Shruti Borle, Associate Member[2], (1)Architectural Nexus, Sacramento, CA, (2)Architectural Nexus, Salt Lake City, UT*

Seminar (Intermediate)

Intelligent Building Operations

This session explores the connection between buildings and various sources of transient data they generate that can be used to improve their operations. First, presenters will discuss the accuracy of self-reported energy consumption from power distribution units (PDUs) commonly used in data centers. Next, presenters will discuss a simulation study that optimized night setback control for space heating loads, energy use, and emissions for a school and office building in Montreal, Canada. Finally, presenters will discuss how data from smart watches can be used to characterize occupantâ€™s well-being and improve indoor environmental quality (IEQ).

1. How Accurate Is the Self-Reported Energy Consumption of Connected Devices?
Anay Waghale *and Michael Poplawski, P.E., Pacific Northwest National Laboratory, PORTLAND, OR*

2. Optimization of Night Setback Control for Thermal Load, Energy and GHG Emissions KPIs
Pedro Guaraldi, P.Eng., Student Member*, Bouthillette Parizeau Inc., Montréal, QC, Canada*

3. How Might Data from Wearable Devices Be Used to Improve Indoor Environmental Quality in Buildings?
Belal Abboushi, Ph.D.*, Sarah Safranek and Yan Chen, Ph.D., Pacific Northwest National Laboratory, Portland, OR*

Seminar (Intermediate)

CFD Applications for Architectural Decision Making

Computational fluid dynamics (CFD) is a long-established, but often avoided, analysis tool for building airflow patterns. CFD has been perceived as a tool with a steep learning curve perhaps best reserved for specialized situations. The Covid pandemic is such a situation, and the first presentation addresses the use of CFD to model Covid mitigation in an office setting. The second presentation demonstrates the use of CFD to expose synergies between design disciplines relative to emerging HVAC system approaches.

1. A Comparison of Covid-19 Mitigation Alternatives in a Typical Open Office Setting Using CFD Modeling
Thomas Squillo, P.E., Member*, Environmental Systems Design, Inc., Chicago, IL*

2. Improved Restaurant Air Quality with Corresponding Energy Efficiency Gains
Steven Forrester, P.E., BCxP and BEMP, Associate Member *and Michael Daly, P.E., Associate Member, DMA Engineering, Golden, CO*

Seminar (Intermediate)

Modeling Advances

This session conveys recent developments that have been made for simulation of novel technology and controls.
The first presentation will discuss simulation and measured data for the EMPOWER smart wall that combines thermal storage and active insulation systems via chilled water connections and advanced power electronics. The third presentation reports on new data regarding building space load profiles. The third presentation presents the results of a large-scale study of end-use energy consumption categories. The fourth presentation reports on the effects on cooling load calculations of varying convective transfer coefficients. The Final presentation presents a Python framework for parametric multizone airflow modeling using CONTAM models.

1. A Python Framework for Parametric Multizone Airflow Modeling
Jason W. DeGraw, Ph.D., Member *and Prateek Shrestha, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Development and Verification of Boiler Plant Control Sequences for a Primary-Only Condensing Boiler Plant, Based on ASHRAE RP-1711
Karthikeya Devaprasad, Associate Member *and Yan Chen, Member, Pacific Northwest National Laboratory, Richland, WA*

3. A New Database of Space Specific Schedules and Loads for Modeling Building for Code Compliance
Yunyang Ye, Ph.D., Associate Member[1]*, Wooyoung Jung, Ph.D.*[1]*, Jian Zhang, Ph.D., Member*[2] *and Yan Chen, Ph.D.*[3]*, (1)Pacific Northwest National Laboratory, PORTLAND, OR, (2)Pacific Northwest National Laboratory, United States of America, Richland, WA, (3)Pacific Northwest National Laboratory, Portland, OR*

4. Effect of Land-Use-Class Based Convective Heat Transfer Coefficient on Cooling Load Estimation
Anwar Demsis Awol[1]*, Girma Bitsuamlak*[2] *and Fitsum Tariku, Member*[3]*, (1)University of Western Ontario, London, Canada, (2)Western University, London, ON, Canada, (3)BCIT, Burnaby, BC, Canada*

5. Empower Wall Cooling Performance Evaluation Based on Building Energy Simulation and Measurement Data
Sungkyun Jung, Ph.D.*, Piljae Im, Ph.D., Member, Borui Cui, Ph.D. and Jin Dong, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN*

Seminar (Intermediate)

Passive Survivability and Resiliency

Strategies that allow buildings to remain thermally survivable and structurally intact during power outages and natural disasters also have the potential to diminish energy needs, improve durability, and reduce costs during normal operation. This session explores the roles of advanced passive heating and cooling design in accelerating progress toward fully decarbonized space conditioning; explores new evidence highlighting the need for improved envelope construction in warming Arctic climates; and explores new methods to quantify the ability of energy efficiency measures to provide thermal resilience during weather-related power outages.

1. Synergies between Energy Efficiency and Resilience
Eliza Hotchkiss, HBDP and BEMP[1], *Tianzhen Hong, Ph.D., Fellow ASHRAE*[2] *and Ellen Franconi, Ph.D., BEMP, Member*[3], *(1)NREL, Golden, CO, (2)Lawrence Berkeley National Laboratory, Berkeley, CA, (3)Pacific Northwest National Laboratory, Richland, WA*

2. Building Durablity in Extreme Climates
Tanushree Charan[1]**,** *Robbin Garber-Slaght, P.E., Associate Member*[2]*, Kaufman Zoe*[3] *and Conor Dennehy*[2]*, (1)National Renewable Energy Laboratory, Golden, CO, (2)Cold Climate Housing Research Center - National Renewable Energy Laboratory, Fairbanks, AK, (3)National Renewable Energy Lab, Golden, CO*

3. The Role of Advanced Passive Systems in the Rapid Decarbonization of Space Heating and Cooling
Alexandra R. Rempel, Ph.D.[1] *and Sandipan Mishra, Ph.D.*[2]*, (1) University of Oregon, Eugene, OR, (2) Rensselaer Polytechnic Institute, Troy, NY*

4. A Building Science Approach to Measuring Community Energy Resilience
Lino Sanchez[1]*, Paul Mathew, Ph.D., Member*[1]*, Luis Fernandes, Ph.D.*[1] *and Sang Hoon Lee, Ph.D.*[2]*, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Lawrence Berkeley National Laboratory, United States of America*

Seminar (Intermediate)

Urban Scale Modeling

The fist presentation delves into building-to-grid interaction through an analysis of the energy and cost performance of a power management system in a connected community using an urban scale building energy modeling framework. Results demonstrate how a connected community can effectively reduce the demand on the grid. The second presents an overview of an alternative data-driven approach to large-scale energy modeling to estimate energy consumption and identify retrofit opportunities. The third presents an overview of the data-driven decisions and methods that were used to create a preliminary building energy model of nearly every U.S. building.

1. Expanding the Scale of Urban Building Energy Modeling
Joshua New, Member[1] *and Brett Bass*[2]*, (1) Oak Ridge National Laboratory, Knoxville, TN, (2) Oak Ridge National Laboratory, Oak Ridge, TN*

2. Data-Driven Approach for Urban Energy Modeling to Support Energy Efficiency Planning
Kevin Keene*, Pacific Northwest National Laboratory, Richland, WA*

3. A Power Management System Approach in Connected Communities by Using an Urban Scale Building Energy Modeling Framework
Yunyang Ye, Ph.D., Associate Member[1]*, Xuechen Lei, Ph.D., Associate Member*[2]*, Jeremy Lerond, Affiliate*[2] *and Jian Zhang, Ph.D., Member*[3]*, (1) Pacific Northwest National Laboratory, PORTLAND, OR, (2) Pacific Northwest National Laboratory, Richland, WA, (3) Pacific Northwest National Laboratory, United States of America, Richland, WA*

Seminar (Intermediate)

Modeling for the Future

The sole presentation in this session looks at generated anthropogenic heat profiles in urban microclimate models to provide a more accurate estimation of urban air temperature rises during heat waves and their effect on electrical grids.

1. City-Scale Anthropogenic Heating from Buildings during Heat Waves
Xuan Luo[1] *and Tianzhen Hong, Ph.D., Fellow ASHRAE*[2]*, (1)LBNL, United States of America, Berkeley, CA, (2)Lawrence Berkeley National Laboratory, Berkeley, CA*