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Center for High Performance Buildings

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**Keywords:** Interface, Exterior Solar Protection Devices, Shading System



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<sup>1</sup>School of Civil Engineering, Purdue University, West Lafayette, Indiana 47907, USA; <sup>2</sup>School of Electrical and Computer Engineering, Purdue University, West Lafayette, Indiana 47907, USA; <sup>3</sup>Center for High Performance Buildings, Ray W. Herrick Laboratories, West Lafayette, Indiana, USA 47907

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<sup>1</sup>Lyles School of Civil Engineering, Purdue University, West Lafayette, Indiana USA; <sup>2</sup>Center for High Performance Buildings, Ray W. Herrick Laboratories, Purdue University, West Lafayette, Indiana USA; <sup>3</sup>School of Mechanical Engineering, Purdue University, USA

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<sup>1</sup>University of Wisconsin-Madison, Madison, WI; <sup>2</sup>Johnson Controls, Milwaukee, WI

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<sup>1</sup>Lyles School of Civil Engineering, Purdue University, West Lafayette, Indiana USA; <sup>2</sup>Center for High Performance Buildings, Ray W. Herrick Laboratories, Purdue University, West Lafayette, Indiana USA

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Wichita State University, United States of America

**Keywords:** PMV, Comfort, Fitbit, Wearable Device

**ID: 3542**

### **Stochastic Modeling of Short-Term Occupancy for Energy Efficient Buildings.....560**

**Jin Dong<sup>1</sup>, Chris Winstead<sup>1</sup>, Seddik M. Djouadi<sup>1</sup>, James J. Nutaro<sup>2</sup>, Teja Kuruganti<sup>2</sup>**

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**Keywords:** Occupancy Modelling, Occupancy Prediction, Energy Efficiency, Building Occupancy, Occupancy-Driven Control

**ID: 3073**

### **A Bayesian Approach for Modeling Occupants' Use of Window Shades.....570**

**Seyed Amir Sadeghi<sup>1</sup>, Nimish M Awalgaonkar<sup>2</sup>, Panagiota Karava<sup>3</sup>, Ilias Bilionis<sup>2</sup>**

<sup>1</sup>Lyles School of Civil Engineering, Purdue University, West Lafayette, Indiana 47907, USA; <sup>2</sup>Department of Mechanical Engineering, Purdue University, West Lafayette, Indiana 47907, USA; <sup>3</sup>Center for High Performance Buildings, Ray W. Herrick Laboratories, West Lafayette, Indiana, USA 47907

**Keywords:** Human-Building Interactions, Bayesian Estimation Technique

**ID: 3233**

### **The Rebound Effect After the Energy Refurbishment of Residential Buildings Towards High Performances.....581**

**Vincenzo Corrado, Ilaria Ballarini, Simona Paduos, Elisa Primo**

DEPARTMENT OF ENERGY, POLITECNICO DI TORINO, Italy

**Keywords:** Rebound Effect, Occupant Behaviour, Energy Retrofit, High Performance Residential Buildings

**ID: 3300**

### **Evacuation Hazards in Crowded Subway Stations.....591**

**M.K. Ho, C.Y. Ku, W.K. Chow**

The Hong Kong Polytechnic University, Hong Kong S.A.R. (China)

**Keywords:** Evacuation, Hazards, Subway Stations

## **B-11: Thermal Storage and Heat Pumps**

*Time:* Wednesday July 13, 2016: 9:45 AM - 12:00 PM — *Location:* 214 C&D

*Session Chair:* Marco Baratieri

**ID: 3349**

### **Performance Evaluation of a Hp/Orc (Heat Pump/Organic Rankine Cycle) System With Optimal Control of Sensible Thermal Storage.....599**

**Carolina Carmo<sup>1,2,3</sup>, Olivier Dumont<sup>4</sup>, Mads P. Nielsen<sup>1</sup>, Brian Elmegaard<sup>3</sup>**

<sup>1</sup>Aalborg University; <sup>2</sup>Insero Energy; <sup>3</sup>DTU; <sup>4</sup>Univ. Liège

**Keywords:** Reversible Heat Pump/Organic Rankine Cycle, Solar Energy, Sensible Thermal Storage, Energy Efficiency

**ID: 3296**

### **Operation of Cool Thermal Energy Storage to Increase Renewable Energy Utilization....609**

**Amy Van Asselt, Douglas T. Reindl, Gregory F. Nellis**

University of Wisconsin, United States of America

**Keywords:** Thermal Energy Storage, Solar Energy, Wind Energy, Peak Load Reduction, Commercial Buildings

**ID: 3543**

### **Dynamic Modeling and Performance Analysis of Sensible Thermal Energy Storage Systems.....619**

**Austin Lee Nash, Neera Jain**

Purdue University, United States of America

**Keywords:** Thermal Stratification, Micro-Chp

**ID: 3491**

### **Optimization of Air Source Heat Pump Systems Over the Heating Season Through the Use of Renewable Energy Sources.....629**

**Elena Bee, Alessandro Prada, Paolo Baggio**

DICAM – Dept. of Civil, Environmental and Mechanical Engineering – Univ. of Trento – Via Mesiano 77 - 38123 Trento (Italy)

**Keywords:** Air Source Heat Pump, Multi Objective Optimization, Thermal Storage

**ID: 3652**

### **Investigation on a Ground Source Heat Pump System Integrated With Renewable Sources.....638**

**Defeng Qian, Fuxin Niu, Steven Kavanaugh, Zheng O'Neill**

the University of Alabama, United States of America

**Keywords:** Solar Energy, Renewable Energy, Geothermal System, Net-Zero Energy Building

**ID: 3308**

### **Heat Pump Assisted Solar Thermal System.....648**

**David Lotz, William Hutzal, William Arnett, Duane Dunlap, Chris Foreman**

School of Engineering Technology, Purdue University, U.S.A.

**Keywords:** Solar Thermal, Heat Pump, Energy Factor

## **B-12: Building Simulation and Optimization**

*Time:* Wednesday July 13, 2016: 1:00 PM - 3:00 PM — *Location:* 214 A&B

*Session Chair:* Hui Shen

**ID: 3415**

### **Energy and Economic Performance Analysis of Heat Recovery Devices Under Different Climate Conditions.....657**

**Stefanie Tafelmeier<sup>1</sup>, Giovanni Antonio Longo<sup>2</sup>, Andrea Gasparella<sup>1</sup>**

<sup>1</sup>Free University of Bolzano, Faculty of Science and Technology, Bolzano, Italy; <sup>2</sup>University of Padova, Department of Management and Engineering, Vicenza, Italy

**Keywords:** Heat Recovery Systems, Climate Influence, Energy Savings, Economic Analysis

**ID: 3446**

### **Gradient-Based Estimation of Air Flow and Geometry Configurations in a Building Using Fluid Dynamic Adjoint Equations.....667**

**Runxin He, Humberto Gonzalez**

Department of Electrical and Systems Engineering, Washington University in Saint Louis, United States of America

**Keywords:** Optimal Control, Indoor Climate Estimation, Building Geometry Configurations Reconstruction, Model

**ID: 3025**

### **Bayesian Calibration - What, Why and How.....677**

**Ralph T Muehleisen, Joshua Bergerson**

Argonne National Laboratory, United States of America

**Keywords:** Energy Model, Bayesian Calibration

**ID: 3458**

### **An Efficient and Accurate Building Optimization Strategy Using Singular Value Decomposition.....684**

**Yeonjin Bae, W. Travis Horton**

Purdue University, United States of America

**Keywords:** Life Cycle Building Optimization, Singular Value Decomposition;

**ID: 3679**

### **State-Space Modeling of Thermal Spaces in a Multi-Zone Building.....692**

**Vahid Raissi Dehkordi, José Agustín Candanedo**

CanmetENERGY - Natural Resources Canada, Canada

**Keywords:** Linear Models, Predictive Control, Thermal Space, State-Space Model

**ID: 3535**

### **Parallel Object-Oriented Algorithms for Building Performance Simulation. Application to an Existing Dwelling.....701**

**Lopez Joan, Capdevila Roser, Souaihi Oussama, Rigola Joaquim, Oliva Assensi**

UPC, Spain

**Keywords:** Building Performance Simulation, Dwelling Buildings, OOP, Parallel Computation, Coupling Algorithms

## **B-13: Ventilation, Passive Cooling and IAQ**

*Time:* Wednesday July 13, 2016: 3:30 PM - 5:30 PM — *Location:* 214 A&B

*Session Chair:* Brandon E. Boor

**ID: 3163**

### **The Air Distribution Around Nozzles Based on Active Chilled Beam System.....710**

**Bingjie Wu<sup>1</sup>, Wenjian Cai<sup>2</sup>, Qinguo Wang<sup>3</sup>, Can Chen<sup>2</sup>, Chen Lin<sup>2</sup>, Haoran Chen<sup>2</sup>**

<sup>1</sup>Energy Research Institute @ NTU (ERI@N), Interdisciplinary Graduate School, Nanyang Technological University, Singapore; <sup>2</sup>School of Electrical and Electronic Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798; <sup>3</sup>Institute for Intelligent Systems, the University of Johannesburg, South Africa

**Keywords:** Air Distribution, Uniformity, Active Chilled Beam, CFD, Thermal Comfort

**ID: 3231**

### **Performance Evaluation of a Passive Chilled Beam System and Comparison With a Conventional Air System.....719**

**Janghyun Kim<sup>1</sup>, James E. Braun<sup>1,2</sup>, Athanasios Tzempelikos<sup>1,2</sup>, W. Travis Horton<sup>1,2</sup>**

<sup>1</sup>Ray W. Herrick Laboratories, School of Mechanical Engineering, Purdue University, 140 S. Martin Jischke Dr., West Lafayette, IN 47907, USA; <sup>2</sup>School of Civil Engineering, Purdue University, 550 Stadium Mall Dr., West Lafayette, IN 47907, USA

**Keywords:** Passive Chilled Beam, Experiment

**ID: 3310**

### **Demand Controlled Heat Recovery for Residential Applications.....730**

**Zhen Li, William Hutzal**

School of Engineering Technology, Purdue University, United States of America

**Keywords:** Heat Recovery, IAQ, Residential

**ID: 3676**

### **Temperature, Relative Humidity, and Carbon-Dioxide Modulation in a Near-Zero Energy Efficient Retrofit House.....739**

**Saurabh Sudhakaran, Mark Shaurette**

Purdue University, United States of America

**Keywords:** Net Zero Energy Building (NZEB), Energy Recovery Ventilator (ERV), Retrofit House Energy Performance

**ID: 3504**

### **Study of Performance Characteristics of a Triple Duty Valve Using CFD.....749**

**Sagar Dilip Jadhav, Shyam Narayan Shukla, Ravindra Sharanappa Birajdar**

Kirloskar Brothers Limited, India

**Keywords:** Triple Duty Valve, CFD, HVAC, High Performance Buildings