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This PACE Newsletter highlights activities and noteworthy events in the PACE program.

For more information or to submit prospective articles, contact the PACE Team at:

PennState.PACE@gmail.com

PACE



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NOVEMBER 2016

AE Welcomes Visiting PACE Fellow Dr. Mike Toole

Professor Mike Toole is serving as our newest PACE Faculty Fellow and has recently begun collaborating with faculty and students through his time visiting Penn State. Professor Toole received his B.S. from Bucknell and his Masters and Ph.D. from the Massachusetts Institute of Technology (M.I.T.) and over the years he has held a wide range of industry positions, including serving as an officer in the Navy, working for Brown & Root Services Corporation, Tonyan Composites Corporation, Ryland Homes, HomeCad, Inc., and Packer Engineering, Inc. While pursuing his graduate work at MIT, Professor Toole also served as a course instructor as well as helping to co-founded three companies. His research interests include process and organization innovation and sustainability.

Currently, Dr. Toole serves as a professor at Bucknell University, where he teaches a range of classes, from construction to engineering classes. More recently, he started a "Grand Scholar's Program" chapter at Bucknell. This program, initiated by the National Academy of Engineers, has identified fourteen problems that engineering students are challenged to tackle in their careers, ranging from making solar energy economical to reverse engineering the brain.

As the PACE Fellow, Dr. Toole is interested in helping students with research. He provides guest lectures at Penn State in ongoing courses within the construction curriculum, and is working with students and collaborating with the faculty to pursue grant proposals and launch projects. "I hope that my partnership will continue on past my time as a PACE Fellow," Dr. Toole said.

He has also been working with Penn State Office of the Physical Plant to talk about implementing "Prevention through Design," which would encourage engineers and architects to think about the safety of construction workers while they are still in the early design stages of the project.

Outside of his work life, Dr. Toole enjoys spending time with his wife, Amy, and is two children. He likes to be outside, exercise, and spend time at his cabin at Penn's Creek, where, he likes to fish and kayak.

For more information on this, or simply to welcome Dr. Toole to the department, please contact him at ttoole@bucknell.edu.



Developing of an Optimization Tool to Optimize the Façade Design across Energy, Material, and Lifecycle Cost Criteria

Due to the high contribution of buildings system design decisions to both long term energy consumption and associated greenhouse gas emissions, reducing building energy use is a key path to decrease buildings' environmental footprint. The purpose of this study is to use an optimization approach to alternative design options, seeking designs that reduce the energy consumption, reduce the environmental impact from material selection, as well as decrease the construction and maintenance costs as early as possible in the design process.

In the current study, a multi-objective optimization model, using the Harmony Search (HS) algorithm, is in development to identify how to best combine design variables, to create a solution that will improve building energy efficiency while also decreasing the life cycle costs. This model considers multiple building envelope materials as design input variables to identify optimum design scenarios with the lowest environmental emissions and life cycle costs.

For more information on this research, please reach out to Ehsan Mostavi (ehsan.mostavi@gmail.com) or Dr. Somayeh Asadi (asadi@engr.psu.edu).

*The secret of change
is to focus all of your
energy, not on
fighting the old, but
on building the new.*

- **Socrates**



Forecasting Occupant Comfort for Improved Energy Model Analysis

Indoor environments should meet the needs of the occupants and enhance their comfort, health and productivity. Efforts to reduce energy consumption often lead to decreased satisfaction for building occupants. These modifications to the environment often cause occupants to change their behavior to improve their personal comfort, often resulting in additional energy use and often cancelling any intended energy improvements.

This study examines how occupant behavior can be more accurately predicted based upon demographics and comfort profiles. Surveys and continuous energy monitoring results provide an in-depth understanding of the indoor environment preferences of the occupants and their energy consumption habits. The data are collected for two case study buildings in Pennsylvania, and two in Doha, Qatar and will be modeled into a machine learning algorithm to forecast occupant comfort desires and behaviors in a space. A simulation platform is being developed that can accept occupant behavior and preferences as inputs and produce corresponding energy consumption behavior data to help better forecast the user impacts for different design decisions. For more information on this research please reach out to Yewande Abraham (YSA104@psu.edu) or Dr. Somayeh Asadi (asadi@engr.psu.edu) and Dr. Chimay Anumba (Anumba@engr.psu.edu).

Graduate Student Collaborates with University of Auckland for BIM and BMS Data Visualization

Graduate student, Jennifer Lather, spent her summer working with Dr. Robert Amor in the Department of Computer Science in Auckland, New Zealand. During this time, they explored BIM and BMS sensor data and current visualization systems typically used by managers and operators of buildings. They were interested in exploring data access and transparency with building occupants and investigated ways to show building operations data to end users of those facilities. She created a pilot interactive data visualization system for viewing building operations data within a 3D environment and explored various levels of data visualization, including building, floor, and room levels. Further research and development into various use cases are currently being explored.

AE CONSTRUCTION FACULTY

Esther Obonyo – eao4@psu.edu

Associate Professor

Somayeh Asadi, PhD—asadi@engr.psu.edu

www.engr.psu.edu/ae/faculty/asadi/

Robert Leicht, PhD - rmleicht@engr.psu.edu

Director of PACE | <http://pace.psu.edu>

John Messner, PhD - jmessner@engr.psu.edu

Director of CIC Research Initiative

www.engr.psu.edu/ae/cic/

David Riley, PhD - driley@engr.psu.edu

Director of Sustainable Energy and
Construction Initiative;

www.cfs.psu.edu



Upcoming Activities

S:PACE Trip to Washington, D.C.

November 11-12, 2016

**Architectural Engineering Department seeking
new Department Head**

Upcoming PACE Events

PACE Seminar Meeting

April 19-20, 2017

Held each spring, the research seminar combines presentations of research results and timely industry speakers for a diverse audience of building industry professional and university students. This year's will be held in the D.C. area.

PACE Advisory Board Meeting

June 9, 2017

Representatives from PACE Member companies meet to discuss key issues facing the building industry, and establish a research agenda for the next year. This year's meeting will be hosted by DPR Construction at their headquarters in Reston, VA.

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