Hess Laboratories Hosts Large-Scale Structural Testing

Masonry Wall

A multi-disciplinary team of engineering faculty and students of the CAEE and MEM Departments have been actively working in the Hess Laboratories at 34th and Ludlow Streets on large-scale testing to establish the seismic performance of a building structural system used throughout the U.S. The project is funded by a $1.5 million National Science Foundation (NSF) research grant entitled: "NEESR: Seismic Performance and Design of Partially-Grouted Reinforced Masonry Buildings." The primary motivation for the project was a 2009 Drexel-led pilot study that uncovered a potentially significant seismic safety issue associated with the widely used and economically competitive building construction approach. Drexel project leaders, Drs. Ahmad Hamid and Franklin Moon, are collaborating with faculty from the University of California-San Diego and the University of Minnesota.

The three-year project, which began in June 2012, recently completed the first of thirteen full-scale structural wall tests in the Hess Laboratories. The specific specimens subjected to controlled, destructive testing are the largest of their kind ever experimentally tested. The results of this initial experiment support the findings of the pilot study. The wall resisted 43,000 pounds of lateral force while the current International Building Code (adopted throughout the U.S.) estimates the lateral-load capacity at 75,000 pounds, nearly 75% greater than measured. Given the observed and significant seismic vulnerability, the secondary objective of the project, which is to develop and validate economically competitive design details and retrofit methods to ensure such structural walls have sufficient seismic safety, has become a major focus of the effort.

In addition to the focus on seismic safety, this project has offered faculty a unique opportunity to validate novel sensing systems on full-scale structural components under destructive force levels. CAEE Assistant Professor Dr. Ivan Bartoli and MEM Assistant Professor Dr. Antonios Konstos implemented innovative sensing approaches during the initial experiment, including Acoustic Emission (ultrasonic sensors capable of detecting structural cracking), Digital Image Correlation (high resolution images capable of establishing full-field displacement fields), and Thermography (thermal images capable of measuring both construction quality and structural damage). These non-invasive sensing approaches hold enormous potential for the rapid safety assessment of buildings and other civil infrastructure. The large-scale validation currently being carried out at the Hess Laboratories is both unique and illustrative of the potential of multi-disciplinary research efforts. CAEE doctoral student Mohammad Bolhassani and CAEE lab technician Greg Hilley have been overseeing project set-up in Hess. Former doctoral student and current Pennoni employee, Ehsan Minaie has provided assistance with effort.

Damage after destructive testing

USDA Funds Research on Bio-Fuels

Dr. Spatari under a willow

CAEE Assistant Professor Dr. Sabrina Spatari is a member of two separate research teams who were recently awarded USDA funding for projects involving the production of biofuels. Dr. Spatari's role in both research efforts is to perform Life Cycle Assessment (LCA) on the production of biofuels generated from the following feedstocks: switchgrass, equine waste, woody biomass/forestry residue, and energy sorghum. Life cycle analysis is an analytical tool or method used to systemically capture environmental impacts as well as potential human health risks. Dr. Spatari's research using LCA is an important component for these research teams to determine the feasibility and effectiveness of biomass development using these previously mentioned feedstocks. Associate Professor Dr. Patrick Gurian will be collaborating with Dr. Spatari on one of these research grants to integrate a risk and uncertainty framework to assess life cycle environmental decision criteria. More information on these awards can be found here.

Drexel Researchers Investigate the 'Energy Efficiency Gap'

Buildings account for about 40% of U.S. Energy use. Will it be possible to reduce energy use by adopting energy efficiency improvements that pay for themselves over time? This depends on how well building owners are able to identify and select appropriate energy efficiency measures when they are upgrading building facilities. The hypothesis that beneficial investments in energy efficiency are not made is often referred to as the "energy efficiency gap" - a gap between the economically justified level of energy efficiency and the level of energy efficiency that is actually achieved. Researchers have debated the size of this gap and whether it even exists.

MS student Michael Hamilton represented the survey effort

CAEE faculty and students from Drexel's Building Science and Engineering Group are investigating the decision processes involved in the building retrofit process to identify whether processes that could create an energy efficiency gap are in fact occurring. The researchers have recruited a pool of 206 specialized survey respondents who have experience in the building retrofit field. The researchers will look at what financial metrics and assessment processes decision makers are using and evaluate whether these processes give theoretically sound results. The survey presents decision makers with different framings or formats of the information about the same fundamental project to investigate if how information is presented to decision makers can change the level of energy efficiency. In addition, the survey addresses participant expectations for energy cost increases in the future. If participants expect large increases in energy costs, they will be more motivated to invest in energy efficiency, but if they expect constant or falling energy costs they may have little incentive to invest in energy efficiency. The result of this survey can inform energy efficiency programs. The study will identify any aspects of decision processes that may contribute to an energy efficiency gap, and enable these aspects to be targeted by programs to provide better information and decision making tools to building owners.

Recent Award from Camille and Henry Dreyfus Foundation

Drs. Peter DeCarlo and Michael Waring received funding ($44,000) from the *Camille and Henry Dreyfus Foundation* for their proposal entitled: *CLEAR PM: Chemistry Lessons Enabling Aerosol Realizations with Particulate Measurements.* As proposed CLEAR PM will stimulate curiosity, understanding, and interest in the chemical composition, formation mechanisms, and properties of particles through real-time analytical measurements and display. This teaching and outreach tool will be invaluable both at the university level where both professors will incorporate it into their undergraduate and graduate courses. This tool is also ideal for community engagement and outreach activities in the broader area. Both PIs continue to participate in a community based research activity specifically looking into particle pollution in the Philadelphia area. CLEAR PM would serve to aid in the discussion of particle sources, and formation in the area.

Student News

CAEE Civil Engineering doctoral students Ben Cohen and Liam Hendricken are recent recipients of the Steven E. Giegerich Memorial Scholarship. This scholarship is awarded annually. In 1984, John Giegerich established this scholarship to honor his son Steven, a Drexel student who passed away from a motorcycle accident. Since its founding, more than 40 Drexel students have benefited from the scholarship. Ben is advised by Dr. A. Emin Aktan and Dr. Sabrina Spatari. Liam is advised by Dr. Jin Wen.

CAEE Civil Engineering doctoral student Seyed Hossein Hosseini Nourzad was recently awarded the Project Management Institute (PMI) Delaware Valley Chapter Scholarship from the PMI Education Foundation. This academic scholarship is awarded to a PMI Delaware Valley Chapter member who is enrolled or applying for an accredited degree program in or related to project management. Hossein is advised by Dr. Anu Pradhan.

CAEE Civil Engineering doctoral student Jared Langevin is a recent recipient of the 2013-2014 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Graduate Grant-in-Aid award. The Society recognizes Jared for his exemplary research titled: *Human Behavior & Low Energy Architecture Linking Environmental Adaptation, Personal Comfort, and Energy Use in the Built Environment.* Jared is a NSF Research Fellow and is advised by Dr. Jin Wen.

Five CAEE doctoral students have recently defended their theses: Kim DiGiovanni (ENVE, Dr. Franco Montalto), Michael Ryan (ENVE, Dr. Charles N. Haas), Neha Sunger (ENVE, Dr. Charles N. Haas), Matthew Yarnold (CIVE, Dr. Frank Moon) and Haibo Zhang (ENVE, Dr. Mira Olson).