

# The Year in Review - 2007



## Background

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Since 1988, the PHRC has served the housing industry in Pennsylvania by carrying out applied research and delivering education, training and technology transfer. The PHRC is located both at the Pennsylvania State University in State College and at the Pennsylvania College of Technology in Williamsport, thus fostering a synergistic combination of research, application, and training capabilities. Through its access to faculty, staff, students, and external consultants, the PHRC addresses many issues related to housing.

The PHRC operates with extensive industry input and involvement. Projects are selected with input and approval from the PHRC's Industry Advisory Council and its Operations Committee. Members include trade associations, product manufacturers and suppliers, government agencies, design professionals, developers and individual builders, and remodelers. This level of industry involvement ensures that projects and services meet the needs of the housing industry.

In addition to support from Penn State and the College of Engineering, the PHRC receives direct funding from the Pennsylvania Builders Association (PBA), the home building industry, and the Department of Community and Economic Development, the Department of Environmental Protection, the Pennsylvania Housing Finance Agency, the Pennsylvania Association of Township Supervisors, the Pennsylvania Construction Code Academy, the U.S. Department of Energy, the Pennsylvania Concrete Masonry Association, the Water Environment Research Foundation, and the Pennsylvania College of Technology. The Hankin Endowment at Penn State also contributes support.

## Training, Education and Outreach Activities

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**PA Housing and Land Development Conference** – For the past 16 years, the conference has served as a forum to discuss and resolve challenges facing the various sectors of the residential construction industry. This year it was held January 17 and 18 in Harrisburg, PA. The first day of the conference focused on technical issues related to the delivery of houses and the latest information on emerging technologies and how to resolve problems facing the industry. It was attended by 152 individuals. Some of the topics included:

- Research at Penn State: From the Laboratory to the Job Site
- IRC 2006 Update
- Optimal Scheduling and MS Project Applications
- Fastener Innovations from Engineering to Inspections
- Innovative On-lot Septic Systems
- Foundation Systems of Relocated Manufactured Housing
- Shallow Frost Protected Foundations
- Emerging Energy Issues
- Manufactured and Modular Housing Issues for Building Code Officials

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The second day of the program focused on emerging planning, design, and regulatory issues affecting the land development industry in Pennsylvania and was attended by 110 individuals. Some of the land development topics included:

- Soil Testing for Land Development and Building
- What is Behind the Rise in Housing Costs
- Pavement Design
- Site Design Issues
  - Construction and Maintenance of Erosion and Sediment Control Measures
  - Potential Impacts of the Alpine Rose Resort Decision
- Stormwater Management
  - Hydraulic Processes
  - Modeling Stormwater Response

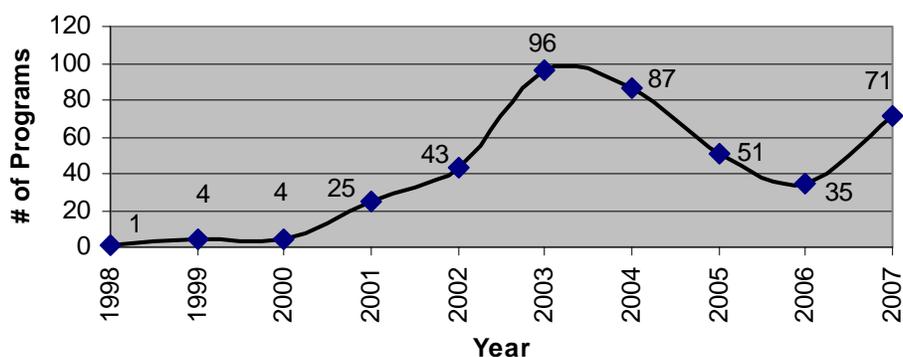
**Workshops and Training** – The PHRC delivered 71 technical workshops to 2,260 builders, remodelers, educators, design professionals and code officials in 2007 (please see the table below for detail). This is roughly twice of the programs held in 2006 (see PHRC Training Programs by Year on next page). One of the biggest surprises was the demand for the 2006 IRC Update Program. 39 programs have been held for 1,448 individuals.

The demand for training was compounded by two factors: the numerous and far reaching new requirements of the 2006 IRC, along with the demand for certification training for building code officials. The registration or grandfathering of existing code officials under the UCC expired on April 8, 2007. We anticipate future demand for building code related training to decline to a maintenance level of around 25 programs a year.

Counting the less formal speaker service and presentations at conferences, the PHRC has provided educational services to over 4,142 individuals during this reporting period.

<b>PHRC Training Programs Delivered</b>			
<b>PROGRAM</b>		<b>Activities for 2007</b>	
		<b># of Programs</b>	<b># of Attendees *</b>
Comprehensive IRC Program	CO1	8	154
International Residential Code Inspection Essentials	CO2	1	21
IRC's Plumbing Requirements	CO3	7	106
IRC's Mechanical Requirements	CO4	4	104
Commercial Building Provisions of the IECC	CO5C	6	166
Residential Energy Essentials	CO5R	4	126
2006 IRC Update Program	CO6	39	1,448
Storm water programs	SW	0	0
Custom Programs	CP	2	135
<b>Total Programs Held</b>		<b>71</b>	<b>2,260</b>

## PHRC Training Programs by Year



**Hankin Distinguished Lecture Series** – The lecture series was established in 2006 to honor Hankin’s family for their continuous and dedicated support of the residential building construction program at Penn State University. This year’s speaker was Dr. David Seiders, Chief Economist of the NAHB and was held Wednesday, November 7, 2007. The title of his presentation was, “Causes and Consequences of the Boom-Bust Housing Cycle in the U.S.”

**Speaker Service** – As a service to the home building and remodeling industry in Pennsylvania, the PHRC offers a speaker service to local and regional associations. The PHRC offers short (20 to 45 minute) sessions, often technical, that address some of the issues or problems that builders and remodelers may be facing. The following presentations have been made by A. Duran, M. Fortney, B. Kasal, and M. Turns:

- Duran, A., *New Residential Land Development Standards for Pennsylvania: Potential for Cost Savings* Centre County Affordable Housing Coalition, State College, March 2007
- Duran, A., *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations*, Centre Regional Planning Agency, State College, April 2007
- Turns, M., Moderator and Speaker, *Energy Efficiency Seminar*, BA of Central PA Home Show, April 2007
- Turns, M., *LEED for Homes* Lecture to CE 370 (Introduction to Environmental Engineering), University Park, April 2007
- Turns, M., *Pennsylvania’s Energy Code*, to Rural Electric Cooperatives, University Park, April 2007
- Kasal, B., *Wall Bracing and Structural Framing Issues*, Harrisburg Builders Association, May 2007
- Fortney, M. *Impact of Building Codes on Superintendents of Residential Construction Projects*, Penn College of Technology, May 2007
- Duran, *New Residential Land Development Standards for Pennsylvania*, PBA Developers Council Harrisburg, June 2007
- Duran, *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations: Pennsylvania Planners Association, Professional Education Subcommittee*, State College, July 2007
- Fortney, M., Turns, M., *The Pennsylvania Experience: Lessons from the Field*, U.S. DOE’s Energy Codes 2007, July 2007
- Kasal, B. *Insulated Concrete Masonry Below-grade Walls*. PCMA Annual Meeting. Harrisburg, July 2007
- Turns, M., Fortney, M., *Energy Code Lessons from the Field*, Centre Region COG, State College, August, 2007
- Turns, M., *Green Building and Remodeling*, Builders Association of Central Pennsylvania Parade of Homes & Landscapes, State College, September 2007
- Duran, *Update on New Residential Land Development Standards for Pennsylvania*, PBA Executive Board, Farmington, PA, November 2007
- Turns, M., *Introduction to Green Building*, seminar at Sun Building Systems annual builder meeting, Scranton, PA, November 2007

## Conferences Attended:

- Fortney, M., ACI New Jersey, Atlantic City, NJ, February 2007
- Duran, A., Fortney, M., Pennsylvania Manufactured Housing Show, Hershey, PA, March 2007
- Fortney, M., Turns, M. Penn Futures Energy Policy Conference, Harrisburg, May 2007
- Fortney, M., Turns, M., Annual State Energy Codes 2007 Conference – U.S. DOE, Pittsburgh, July 2007
- Kasal, B., Wind Summit, Ames, Iowa. July 2007
- Kasal, B., PCMA Annual Meeting, August 2007
- Fortney, M. Building Science Symposium, Westford, MA, August 2007
- Fortney, M., Turns, M., Pennsylvania Residential Energy Forum, Harrisburg, September 2007
- Kasal, B., International RILEM week, Ghent. Belgium, September 2007
- Kasal, B., Housing Education and Research Association (HERA) Conference, Charlotte, NC, Sept. 2007
- Kasal, B., The Masonry Association Annual Meeting, November 2007
- Turns, M., Fortney, M. Ecobuild Fall 2007, Washington, D.C., December 2007

## Conference Presentations:

- Kasal, B. *Wind Load Effects on Residential Structures* – work at Penn State. Wind Summit. Ames. Iowa. (invited presentation)
- Duran, *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations: PSATS Municipal Planners Association*, Hershey, April 2007
- Duran, *New Residential Land Development Standards for Pennsylvania: Engineering Level Considerations : PSATS Municipal Engineers Association*, Hershey, April 2007
- Duran, *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations: Pennsylvania Housing Finance Agency Annual Conference*, Harrisburg, April 2007
- Duran, *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations: Congress for the New Urbanism Annual Conference*, Philadelphia, May 2007
- Turns, M., Fortney, M., *How to Administer Pennsylvania's Energy Code: Lessons from the Field*, U.S. DOE's Energy Codes 2007, Pittsburgh, July 2007
- Kasal, B. *Insulated Concrete Masonry Below Grade Walls*. PCMA Annual Meeting, Harrisburg, August 2007 (invited lecture)
- Kasal, B., and J. Laquatra. 2007. *Housing Research in the US – Where Are We Going?* 2007 Housing Education and Research Association (HERA) Conference. Charlotte, NC. Sept 2007
- Fortney, M., *Pennsylvania's Housing Stock and Energy Policy Perspective*, Pennsylvania Residential Energy Forum, Harrisburg, September 2007
- Duran, *New Residential Land Development Standards for Pennsylvania.: Planning Level Considerations: Design on the Delaware Conference*, American Institute of Architects, Philadelphia, October, 2007
- Duran, *New Residential Land Development Standards for Pennsylvania: Planning Level Considerations: Lancaster County Affordable Housing Summit*, Lancaster, PA, November 2007
- Kasal, B. *Insulated Concrete Masonry Below Grade Walls*. The Masonry Society Annual Meeting. Pittsburg, November 2007 (invited lecture)

**WWW Site** – The PHRC continues to improve the web site ([www.engr.psu.edu/phrc](http://www.engr.psu.edu/phrc)) to help disseminate information. Newly designed homepages are currently being tested.

## **Pennsylvania Focus Committees:**

- Pennsylvania Department of Environmental Protection (DEP), Oversight Committee – Pennsylvania Stormwater Management Manual
- Pennsylvania Builders Association (PBA)—(Training and Education Committee, Land Development Task Force, Housing Finance Committee, and PHRC Committee)
- Advisory Council for the Modular Housing Training Institute (MHTI)
- Advisory Council for the Manufactured Housing Resource Center (MHRC)
- Builder Association of Central Pennsylvania
- Pennsylvania Concrete Masonry Association, Codes Committee

## **National and International Focus Committees:**

- National Consortium of Housing Research Centers
- SACoMaTiS 2008: International RILEM Conference: On Site Assessment of Concrete, Masonry and Timber Structures, Organizing Committee, Editor
- Building Environment and Thermal Envelope Council (BETEC)
- RILEM, Technical Committee TC 215 AST Chair
- National Institute for Building Sciences (NIBS)
- International Council for Research and Innovation in Building and Construction – Working Commission W-18 – Timber Structures

## **Publications**

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The PHRC produces a wide array of publications to provide technical information to the construction industry and to disseminate results of research projects.

### **Standards:**

Fortney, M. Glantz, B., Jellen, A., *Foundation Systems for Relocated Manufactured Housing: Pennsylvania Field Guide*, May 2007

Brown S., Foster K., Rios M., Duran A., *Pennsylvania Standards for Residential Site Development*, April 2007

### **Reports:**

Turns, M., Fortney, M., *Potential Benefits of Implementing a Statewide Residential Energy Efficiency Program in Pennsylvania*, PHRC Research Series Report No. 100, April 2007

Semon, N., *Net Zero Energy Homes in Central Pennsylvania: A Case Study in Feasibility*, PHRC Industry Advisory Council Report, July 2007

### **Builder Briefs:**

Kasal, B., Crandell J., *Part 1: Basic Components for Code Compliant Bracing*. BB0807. March 2007

Line, P., Showalter J., Taylor R., *2005 National Design Specifications® (NDS®) for Wood Construction*, BB0907, June 2007

Crandell, J., Kasal B., *Part 2: IRC Wall Bracing Requirements*. BB1007. July 2007

Crandell, J., Kasal B., *Part 3: Beyond Code Wall Bracing Solutions*. BB1107. July 2007

## Research Papers:

The research publications not only disseminate the technical information to the public but increase the state, national and international reputation of the PHRC. As such, they are an important component of our mission.

Kasal, B., and R. Anthony. 2007. Semi-destructive techniques for in-situ evaluation of historic wood structures. In Proceedings from NSF/MSMT Workshop In-Situ Evaluation of Historic Wood and Masonry Structures. L. Binda, M. Drdacky, and B. Kasal, Editors. (Book) ITAM Prague. ISBN 978-80-86346-36-9. 42-59.

Pospisil, S., B. Kasal, and M. Drdacky. 2007. Konstrukce dřevěného rámu pro oblasti s častým výskytem zemetřesení (Design of timber frame for regions with high seismicity). [in Czech]. iMaterialy. Springer Media Cz. August 2007. (<http://www.imaterialy.cz/clanky/poruchy/782/konstrukce-dreveneho-ramu-pro-oblasti-s-castym-vyskytem-zemetreseni/>).

Memari, A. M., and B. Kasal. 2008. Comparison of In-plane Lateral Load Resistance of Interior Steel Stud and Wood Stud Light-Frame Walls ASCE Structures Congress 2008, Vancouver, Canada, April 24-26, 2008. (in print).

Kasal, B. (Editor/Author). 2007. State-of-the-art in in-situ assessment of timber. RILEM TC AST 215 Special Publication. RILEM Paris (in review).

Kasal, B., and R. Anthony. 2007. Education in Engineering Evaluation and Rehabilitation of Historic Structures – U.S. Perspective. Proceedings from NSF/RILEM Workshop In-Situ Evaluation of Historic Wood and Masonry Structures (July 10-14, 2006 – Prague, Czech Republic). RILEM Paris. (accepted for publication).

Kasal, B., and R. Anthony. 2007. Advances in in-situ evaluation of timber structures. Proceedings from NSF/RILEM Workshop In-Situ Evaluation of Historic Wood and Masonry Structures (July 10-14, 2006 – Prague, Czech Republic). Reprint from: Progress in Structural Engineering and Materials. John Wiley & Sons Ltd. London. UK. Vol. 6 No 2 April-June 2004. 94-103. RILEM Paris. (submitted for publication).

Heiduschke, A., B. Kasal, and P. Haller. 2007. Performance and drift levels of tall timber frame buildings under seismic and wind loads. Structural Engineering International. (Invited publication - accepted for publication).

Saralde, T. C. Jr., P. N. Peralta, I. Peszlen, and B. Kasal. 2007. Mechanical Properties of Lumber From Partially Cad-Deficient Loblolly Pine (*Pinus Taeda*.) Wood and Fiber Science (submitted for publication).

Kasal, B., and J. Laquatra. 2007. Housing research in the US – where are we going? 2007 Housing Education and Research Association (HERA) Conference. Charlotte, NC. Sept 2007. CD ROM Publication.

Kasal, B., I. Peszlen, P. Peralta, L. Li. 2007. Preliminary tests to evaluate the mechanical properties of young trees with small diameter. *Holzforschung*. Vol. 1 (4): 390-393.

## Research Activities

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**Insulated Concrete Masonry Below-grade Walls** - This project addressed the issues related to the insulating below-grade concrete masonry unit (CMU) walls. The objective of this project was to develop and document a better understanding of the hygrothermal performance of these below grade wall systems. Nine wall segments were simultaneously tested in the environmental chamber – eight CMU units; and one concrete control. Two soil types (sand and clay) are used on the exterior. Various insulation strategies were investigated. 324 different configurations and environmental conditions were tested. Technical reports and builders briefs are expected to be prepared in the 2nd quarter of 2008. The results should allow improvement in CMU basement walls insulation strategies to prevent moisture penetration, molds and energy losses. This project was funded by the Commonwealth of Pennsylvania and Pennsylvania Concrete Masonry Association with matching funds from Penn State University and the Hankin endowment. Status: finished. Report finished. Brief under preparation.

**Comparison of Lateral Load Performance of Wood Stud and Steel Stud Partition Walls** – The goal of this project was to study the lateral resistance of interior partition walls. Such walls can be used as bracing elements in residential structures thus releasing the demand on exterior wall bracing. Steel and wood stud portion walls were tested. This is a preliminary research that should generate enough data to pursue additional funding that will allow the research scope needed to generate data sufficiently reliable to be used for code-related information. Technical reports will be written in the 1<sup>st</sup> quarter of 2008. This project was funded by the Commonwealth of Pennsylvania with significant matching funds from Penn State University and the Hankin Endowment. Status: finished. Report and brief under preparation.

**Ultimate Near Zero Energy Home** – This is a relatively small project involving monitoring of a ‘near-zero energy’ home. Energy consumption is monitored throughout the year by recording the gas flow, water flow, electricity and gas bills, and temperatures. Status: Finished. Undergraduate student report is available.

**The Penn State Solar Decathlon** – The solar decathlon is a U.S. Department of Energy competition of student teams from across the country that takes place in Washington DC. Although this is not a research endeavor, the presence of Penn State and PHRC is deemed important. The PHRC supported the solar decathlon team by direct financial contribution, which was about two percent of the total project cost. The competition took place in mid October of 2007 and the Penn State team finished 4<sup>th</sup>.

**Analysis of Light-Frame Wood Buildings under Wind Loads** – The objective of this research is to refine existing analytical models for analysis of light-frame low-rise buildings and develop new models suitable for stochastic analyses. Results from series of in-situ instrumented tests will be used to verify the models. Then, the models will be extended to include stochastic (random) character of loads and resistances. A PhD student continues the work on the project that is funded by PSU funds with significant contributions by Canadian collaborators.

**Property Evaluation of Genetically Engineered Wood From Aspen with Down-Regulated Lignin Enzymes** – This is a three-year project funded by a USDA Competitive Grant program. Scientists are able to alter the genetic composition of trees and influence the chemical components of the wood. This may result in changes of mechanical properties that control the design parameters of structural wood products (such as lumber). Methods are being developed to study the effects of genetic treatment on wood mechanical and physical properties. The project is in the second year and laboratory test methods were developed and tested. Several publications were prepared. This is a fundamental research that can have a potentially large impact on wood construction.

## **Applied Activities**

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**Foundation Systems for Relocated Manufactured Housing** – The PHRC formed an industry based steering committee to develop prescriptive foundation systems for the relocation of existing HUD code homes. The industry was facing challenges relocating units that no longer have the manufacturers approved foundation systems. Lacking these manufacturers’ allowed systems, local building code officials are requiring expensive full perimeter foundations. This project developed prescriptive systems that are acceptable within the framework of the PA UCC or could be formally adopted by the Pennsylvania Legislature. The project was completed in April and the blue covered Pennsylvania Field Guide: Foundation Systems for Relocated Manufactured Housing was printed May 2007. The PHRC is developing a training program for building code official and installers. PMHA, with cooperation from DCED, is anticipating introducing legislation to adopt this standard in the Commonwealth.

**PA Standards for Residential Land Development** – The document was completed in late April 2007. Limited copies were printed and made available to members of the Land Development Consortium and to members of the PHRC IAC.

The document is available to the general public in two ways. First, it is posted on the PHRC web site. Sample files are freely available to the public. Complete files for each chapter require a password which PHRC supplies without charge. Second, spiral bound copies are available for \$45 from a print on demand vendor.

Numerous conference presentations have promoted the standards to state-wide organizations including the Pennsylvania Housing Finance Agency and the Pennsylvania State Association of Township Supervisors and the Pennsylvania Planning Association. The PHRC continues to seek additional funding sources to assist in promotional, educational and technical assistance efforts to accelerate the adoption of the standard by local governments.

Short feature articles on the standards have appeared in publications including the Keystone Builder (PBA), the Township News (PSATS) and the Land Development Magazine (NAHB).

**Pennsylvania's Alternative Residential Energy Provisions** – The PHRC updated the Pennsylvania's Alternative Residential Energy Provisions (PA-Alt) in May 2006. The PA Department of Labor and Industry adopted the 2006 PA-Alt at the end of 2006. The PHRC made an electronic copy available for free on the web site and provides on-going technical support to builders, design professionals and building code officials on the standard.

**West Penn Power Sustainable Energy Fund (completed)** - The PHRC has completed all deliverables under a grant from the West Penn Power Sustainable Energy Fund that focused on the implementation of a statewide energy efficiency or green building program. As a part of this effort the PHRC completed reports titled, *Summaries of Energy Star Homes Activity and Lessons Learned in Selected States and Regions*, and *Potential Benefits of Implementing a Statewide Energy Efficiency Program in Pennsylvania, PHRC Research Series Report No. 100*.

**U.S. Department of Energy Grant** - Work nearly complete on a project funded by a grant from the U.S. Department of Energy, in partnership with the Pennsylvania Department of Environmental Protection. This project focuses on the implementation of the 2006 IECC, and includes the following activities: (1) code official certification training, (2) advanced training of building code officials, (3) 2006 IECC transition programs, (4) train-the-trainer programs, (5) energy code administration and enforcement, (6) evaluation of energy code compliance, (7) coordination and information sharing, and (8) development and distribution of energy code training materials.

Under tasks 5 and 6, a PHRC team visited twelve municipalities and third party agencies to review their energy code enforcement processes, including plan reviews and inspections. Participating code offices represented a diverse geographical cross-section of Pennsylvania. Home energy diagnostics, including blower door tests, duct blaster tests, and infrared scans were also performed. A report summarizing findings from this project will be available to the public in the Spring of 2008.

## **Funding Sources**

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The PHRC draws support from a variety of sources including state agencies, federal government and industry both at the Pennsylvania Housing Research Center at The Pennsylvania State University and the Pennsylvania Housing Resource Center at the Pennsylvania College of Technology. Below is a listing of supporting agencies for 2007:

- Brick Industry Association
- Hankin Endowment
- Members of the Pennsylvania Housing Research Center (PHRC)
- National Science Foundation (NSF)
- North Carolina State University
- PA Department of Transportation (PennDOT)
- Pennsylvania College of Technology
- Pennsylvania Concrete Masonry Association
- Pennsylvania Construction Code Academy (PCCA)
- Pennsylvania Department of Community and Economic Development (DCED)
- Pennsylvania Department of Environmental Protection
- Pennsylvania Housing Finance Agency
- Pennsylvania State University
- U.S. Department of Agriculture (USDA)
- U.S. Department of Energy
- Water Environment Research Foundation (WERF)
- West Penn Power Sustainable Energy Fund

## Proposals & Contracts

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The PHRC continuously seeks to leverage funding from the Commonwealth with funds from other sources. The following is a list of proposals submitted during 2007 that totaled well over two million dollars.

### Proposals Submitted:

- Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) - *Demonstration of Storm Water Curb Extensions as an Urban Retrofit and Community Amenity*
- DOW Chemical - *Hygro-Thermal Performance of Imperfectly Protected Bellow-Grade Walls with Interior Insulation*
- FEMA - *Wind Hazard Mitigation for Irregular Residential Structures in Hurricane-Prone Regions*
- Green Building Alliance - *Decentralized Electrolysis of Ammonia from Separated Urine to Reduce Nitrogen Loading to Municipal Treatment Plant (Proof of Concept)*
- NSF - *Earthquake resistant hybrid multistory frames with passive stiffness control*
- NSF - *Modeling of Pressure Induced Damage to Low-Rise Buildings Due to Extreme Wind Events*
- NSF - *Stochastic Approach for Virtual Testing of Wind Loaded Buildings in Hurricane Prone Regions*
- PSATS – *Training Program for Public Officials on the PA Land Development Standards*

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