

The Year in Review - 2006



Background

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, 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 Commonwealth of Pennsylvania through the Department of Economic and Community Development, the Department of Environmental Protection, the Department of Labor and Industry, the Pennsylvania Housing Finance Agency, the Pennsylvania Association of Township Supervisors, the Pennsylvania Construction Code Academy, the Department of Energy, the Pennsylvania Concrete Masonry Association, the Water Environment Research Foundation, PennDOT, the West Penn Power Sustainable Energy Fund, the Pennsylvania College of Technology, and Life and Independence for Today. The Hankin Endowment also contributes support.

Training, Education and Outreach Activities

14th PA Housing Conference - The PHRC held the annual Pennsylvania Housing Conference in two locations, Pittsburgh and Valley Forge, in February. The conference is the premier event for the housing industry in Pennsylvania and addresses emerging technical and policy issues.

This year's conference addressed such topics as:

- Changes in your liability under the UCC
- Concrete systems for housing
- Changes between the 2003 and 2006 IRC
- Avoiding building failures and loss mitigation
- Emerging energy issues for builders
- It begins with the site

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Presentations are available to view at www.engr.psu.edu/phrc. The programs were attended by 235 builders, remodelers, architects, engineers and building code officials. Some of the comments received included:

Hit topics that were important to my business. (Builder)

I loved the variety of topics presented and the knowledge of the presenters. (Builder)

I was exposed to many new concepts, I was very impressed! (Building Code Official)

A lot of good information quickly. (Architect)

2nd Annual Land Development Conference - The Pennsylvania Land Development Conference is an annual forum that addresses emerging planning, design, and regulatory issues affecting the residential development industry in Pennsylvania. The theme of this year's conference was demographic, planning and technical trends driving Pennsylvania's residential development market.

This year's topics included:

- A legal perspective on changing land use law and regulations
- Community growth patterns...past, present and future
- A report on land use and growth management in Pennsylvania
- PA's Stormwater Best Management Practices Manual, an update
- Residential infrastructure design for sustainable development
- Trends in on-lot community based sewage treatment systems
- Regulatory requirements for innovative on-lot community based sewage treatment systems

Presentations are available to view at www.engr.psu.edu/phrc. This year's conference was attended by 110 developers, planners, landscape architects, engineers and regulators. Some of their comments include:

The conference dealt with current and future issues that affect my profession.

Great no nonsense approach.

Great opportunity to communicate with others in the industry!

Workshops and Training – The PHRC provides a wide array of training, education and technology transfer services to builders, remodelers, building code officials, design professionals, teachers, home inspectors realtors, bankers and other professionals in the construction industry. Over 955 individuals participated in 36 workshops/seminars during 2006. During this calendar year the PHRC passed an important milestone surpassing the 10,000 person trained through our industry-based programs. The following is a summary of the formal training events we put on during 2006. For a full description of the workshops please visit www.engr.psu.edu/phrc/workshops.htm.

PHRC Training Programs Delivered			
PROGRAM		Activities for	
		10/12/06 – 04/12/07	
		# of Programs	# of Attendees
Comprehensive IRC Program for Code Officials	CO1	6	179
International Residential Code Inspection Essentials	CO2	2	37
IRC's Plumbing Requirements for Code Officials	CO3	3	54
IRC's Mechanical Requirements for Code Officials	CO4	4	61
Commercial Building Provisions of the IECC	CO5C	1	20
Residential Energy Essentials	CO5R	3	48
2006 IRC Update Program	CO6	11	424
Stormwater Management in PA – A New Approach	SW1	4	110
Custom Programs	CP1	2	22
Total Programs Held		36	955

The following is a discussion of program developments and changes:

- **2003-2006 IRC Update Program:** The PHRC developed a new program to help prepare builders, remodelers, design professionals and building code officials prepare for updating to the 2006 International Residential Code (IRC). This training program will provide an overview of major changes and what it may mean to house designers, builders or how a building code officials may need to change their plan review or inspection processes to capture these changes. By the end of 2006 the PHRC has held 11 of these programs and has extremely high interest for additional programs in the first half of 2007.
- **Commercial Energy Code Training:** The PHRC with support from the U.S. Department of energy has developed a 2-day training program that focuses on the commercial building provisions of the 2003 International Energy Conservation Code. Topics include:
 - UCC Administrative Requirements
 - General Administration
 - Building Planning
 - Building Envelope
 - Mechanical Systems
 - Electrical Power and Lighting Systems
 - Building Services Systems and Equipment
- **Stormwater Management in a New Age: Understanding the Physical Processes and Analytical Tools** – the PHRC received a contract with PennDOT to deliver this three-day workshop stormwater management training to Department Personnel. The first day focused on Hydrology and Surface Runoff Processes. The sessions presented were: PA's Stormwater Manual-Update, Standards and Regulation, Typical Stormwater Problems, Surface Runoff Processes, and Hydrologic Methods-Assumptions and Application. The second day's focus was on Soils and Infiltration Processes and covered the following topics: Stormwater BMP's for Volume & Quality Control, Soil Morphology and Mapping, Infiltration and Percolation, Assessing Site Infiltration Capacity-

Methods, Variability, and Cost, and then there was a field trip to an Agronomy Farm. The last day covered Computational Methods and Applications which included these sessions: Computational Methods for Assessing Site Infiltration, and Case Studies Workshop.

- ***PA Construction Code Academy:*** The PHRC has partnered with the Department of Community and Economic Development (DCED)’s Governor’s Center for Local Government Services, the Pennsylvania State Association of Township Supervisors (PSATS) and the Pennsylvania State Association of Boroughs to provide training for the Pennsylvania Construction Code Academy (PCCA). The PCCA is the Commonwealth’s mechanism to provide building code related training to local government officials and employees. Most of the CO (Code Official) programs on the above table were delivered through the PCCA. The PHRC organized and held a planning session to evaluate their short-term training initiatives. This meeting included representatives from all of the code organizations in Pennsylvania, including: the International Code Council (ICC), the Pennsylvania Building Official’s Council (PennBOC), Pennsylvania Association of Code Officials (PACO), Pennsylvania Association Building Code Officials (PABCO) and Lancaster County Building Officials.
- ***Administering and Enforcing Pennsylvania’s Energy Code Requirements (CO5A):*** This new two-day program was developed to give building code officials, inspectors and plan reviewers a well rounded background on enforcing the new energy code provisions. This program provided a detailed overview of insulation materials and their application and general material properties as well as an introduction to applied building science principals. The second day focuses on performing plan reviews and inspections. This program was developed under contract with the U.S. Department of Energy and delivered through the PCCA.
- ***Commercial Building Provisions of the IECC (CO5C):*** The PHRC completed the development of a 2-day program for building code plan reviewers and inspectors on the commercial building provisions of the International Energy Conservation Code (IECC). This program provides an overview of the commercial building provisions of the IECC and help participants prepare for the ICC Certification required by the Commonwealth of Pennsylvania. This program was developed under contract with the U.S. Department of Energy and delivered through the PCCA.
- ***International Residential Code Inspection Essentials:*** The PHRC developed a new program for new and experienced building code officials on performing inspection for the IRC. This two-day course provides the underlying technical background upon which building codes are based, including basic structural engineering concepts, the structural properties of soils and concrete, and key construction and inspection details of wood, masonry, siding and roofing. The course will improve participants’ technical understanding as well as help them make more informed inspection and enforcement decisions. Topics include:
 - Improving building code inspection and enforcement
 - Structural fundamentals
 - Understanding soils and inspecting foundations
 - Understanding and inspecting concrete
 - Building planning inspection issues
 - Inspecting conventional wood framing

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. The first Hankin Distinguished Lecturer was Professor Peer Haller from the University of Dresden, Germany. Professor Haller is the recipient of the 2005 Sachsische Holzbau Prize awarded for the best design of the year and the 2005 European Innovation Prize.

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. This service is provided at no charge to the local builders associations and other interested groups. The PHRC offers short (20 to 45 minutes) sessions, often technical, that

address some of the issues or problems that builders and remodelers may be facing. Since October, the following presentations have been made by M. Fortney, B. Kasal, S. Brown and M. Turns:

- *Managing Surface Runoff from the Build Environment*, Construction Technology Student Chapter Meeting, Penn College, Williamsport, January 24th, 2006 (25 in attendance)
- REScheck overview, Builders Association of Mercer County, Sharron, January 2006
- *2006 IRC Update*, Pennsylvania Builders Association Board of Directors Meeting, Philadelphia February 2006
- *Emerging Housing Issues*, Penn State Cooperative Extension Agents, University Park, March 2006
- *2006 IRC Update*, West Branch Susquehanna Builders Association, Williamsport, March 2006
- *Understanding Hydrologic and Hydropedologic Processes for Better Stormwater Management*, 2006 Engineers' Workshop sponsored by the Westmorland Conservation District, Greensburg, PA, March 9, 2006. (250 in attendance)
- *Understanding Hydrologic and Hydropedologic Processes for Better Stormwater Management*, Current Issues in Stormwater and Wetland Regulations, Sponsored by Lorman Education Services, Philadelphia, PA, March 29, 2006. (45 in attendance)
- *Building Codes in PA*, Pennsylvania College of Technology, Williamsport, April 2006.
- *Key changes in the 2006 IRC*, Pennsylvania Builders Association Board Meeting, Hershey, PA, October 2006
- Executive officers update to the UCC, Executive Officers Council, Pennsylvania Builders Association, State College, PA, October 2006
- "What's New with the IECC?," Nuts and Bolts of Green Building, Sponsored by the Energy Coordinating Agency, Delaware Valley Regional Planning Commission, Philadelphia, PA, November 2006
- *Key changes in the 2006 IRC*, Builders Association of Metro Harrisburg, Cranberry Township, PA, October 2006
- *PHRC Research Overview*, Builders Association of Central PA, State College, November 2006
- *PHRC Overview*, Susquehanna Valley Builders Association, Sunbury, November 2006

Web Site – The PHRC continues to improve the web site (www.engr.psu.edu/phrc) to help disseminate information. An executive summary from each of the reports as well as "builder", "research" and "technical" briefs are available on-line.

Developmental Activities

Land Development Consortium – A land development consortium has been brought together to provide oversight for the Residential Development Guidelines project. This consortium includes representatives of regulatory agencies, builders, contractors, design professionals, and environmental groups. The consortium met on February 10th, June 30th and December 1st.

Standards for the Relocation of Manufactured Housing – The PHRC has meet with the Pennsylvania Manufactured Housing Association (PMHA) to investigate the development of alternative foundation systems for the relocation of existing HUD code homes. The industry is facing challenges relocating units that no longer have the manufactures approved foundation systems. Lacking these manufacturers' allowed systems local building code officials are requiring full perimeter foundations. This project is exploring the development of specific engineered systems that would be acceptable within the framework of Pennsylvania's Uniform Construction Code (UCC).

Subdivision Design Guidelines – The PHRC continued its work to create a uniform set of residential development guidelines for Pennsylvania. During this report period, we worked primarily on the streets section of the guidelines document. In July, we held a meeting to review the streets chapter. Since that time we have been working on final revisions to the streets chapter and have started on the initial draft of the non-vehicular circulation portions of the manual. During this period, we were also awarded an additional grant in support of residential standards from the Water Environment Research Foundation.

PA Stormwater Management Policy and Manual – The PHRC submitted formal comments critiquing DEP's proposed stormwater management policy. These comments focused on technical issues in the manual and exceeded 20 pages in length. The oversight committee met in March and September to review the progress on the manual.

The PHRC has also offered to provide technical assistance to DEP with the final revision process. The level of assistance offered was to meet with Department Staff and make specific recommendations on needed manual restructuring and critical content revisions. We have also offered to work with the consultant on a one-on-one basis to provide oversight on the specific revisions suggested. Copies of our comments are available to PHRC members upon request.

West Penn Power Sustainable Energy Fund Green Building Program – The PHRC’s contract with the West Penn Power Sustainable Energy Fund (WPPSEF) was officially signed into place in November. Prior to the signing of the contract, the grant was unexpectedly divided between three competing proposals resulting in a de facto partnership between the PHRC, MaGrann Associates and Affordable Comfort, Inc. The proposed ENERGY STAR Homes program morphed into a green building program based on the NAHB Green Building Guidelines, and garnered an endorsement from the PBA. ENERGY STAR will remain a part of the program, at least initially, as the baseline for the energy efficiency section. Currently the PHRC is working on a policy report that will identify target housing markets and the potential energy savings, dollar savings and emissions reductions resulting from the implementation of the green building program.

Applied Research Activities

Insulated Concrete Masonry Below-grade Walls - This project addresses the issues related to the insulated concrete masonry below-grade walls. The objective of this project is to develop and document a better understanding of the hygrothermal performance of these wall systems below grade. Nine wall segments are 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 are investigated. The project is currently underway and is expected to continue through 2007. This is relatively extensive project with 324 different tests. Technical report and builders brief are expected to be prepared in the 4th quarter of 2007. The results should allow improvement in CMU basement walls insulation strategies to prevent moisture penetration, molds and energy losses. This project is funded by the PHRC and Pennsylvania Concrete Masonry Association with matching from Penn State University and Hankin funds.

Comparison of Lateral Load Performance of Wood Stud and Steel Stud Partition Walls – The goal of this project is 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 partition walls were tested and results are currently being processed. 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 report will be written in the 4th quarter of 2007. This project is funded by the PHRC with significant matching from Penn State University and Hankin funds.

Simplified Analysis of Light-Frame Wood Buildings under Wind Loads - The objective of this research was the development of simplified analytical models of low-rise buildings that could be used to determine the failure probability under wind loads. We have developed two simple models that can be used to estimate forces in the shear walls. This information is critical for establishing realistic guidelines for wall bracing in residential structures. One article was published and presentation was made at an international conference. Currently, additional funding is sought to perform series of simulations and develop database that can be used to improve the current prescriptive design codes. This project was fully funded by the USDA.

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 (budget \$428,000). 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 second year and laboratory test methods were developed and tested. Several publications were prepared. This is a fundamental research that can have potentially large impact.

International Workshop: In-Situ Evaluation of Masonry and Wood Structures –

This project, funded by the National Science Foundation was finished in 2006. An international workshop that was held in Prague, Czech Republic in June 2006 brought together leading scientists from 9 countries. The workshop was organized under the leadership of Dr. Kasal who is also a chairman of the RILEM Technical Committee on In-situ assessment of wood structures. Proceedings will be published in 2007.

Presentations (Kasal)

- Stochastic analysis of wind loaded light-frame low-rise buildings using simplified analytical models. In Proceedings from the 9th World Conference on Timber Engineering. Portland, OR, 2006.
- Field investigation of the 14th century Castle Pernstejn before and after fire damage. In Proceedings from the 2006 Architectural Engineering Institute Conference. Omaha, NE, 2006.
- Laminated timber frames under dynamic loads. Annual conference of the Forest Products Society. Newport Beach, CA. 2006.
- In-Situ Evaluation of Historic Wood Structures. University of Dresden, Germany. 2006.
- Education in engineering evaluation and rehabilitation of historic structures – US prospective. NSF/RILEM Workshop on Evaluation of Historic Masonry and Wood Structures. Prague, Czech Republic, 2006

Funding Sources

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 2006:

- Ben Franklin Partnership
- Brick Industry Association
- National Science Foundation
- Pennsylvania College of Technology
- Pennsylvania State University
- North Carolina State University (USDA)
- Pennsylvania Concrete Masonry Association
- Pennsylvania Construction Code Academy
- Pennsylvania Housing Finance Agency
- Pennsylvania Department of Community and Economic Development
- Department of Environmental Protection (U.S. Department of Energy)
- DCED Governor's Center for Local Government Services (PSATS)
- Members of the Pennsylvania Housing Research Center
- PA Department of Transportation (PennDOT)
- Water Environment Research Foundation (WERF)
- West Penn Power Sustainable Energy Fund

Proposals

The PHRC actively pursues funding from a variety of sources. In 2006, the PHRC submitted 13 proposals totaling over \$1,500,000 to the following agencies:

- Ben Franklin Partnership
- DCED Governor's Center for Local Government Services (PSATS)
- National Science Foundation
- North Carolina State University (USDA)
- Oak Ridge National Laboratory
- Pennsylvania Construction Code Academy
- Pennsylvania Department of Community and Economic Development
- Pennsylvania Department of Environmental Protection
- Pennsylvania Department of Transportation (PennDOT)
- Pennsylvania Energy Development Authority
- U.S. Department of Energy
- Water Environment Research Foundation (WERF)
- West Penn Power Sustainable Energy Fund (WPPSEF)

Publications

Research publications

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.

- Fischer, C., and Kasal, B. 2006. Stochastic analysis of wind loaded light-frame low-rise buildings using simplified analytical models. In Proceedings from the 9th World Conference on Timber Engineering. Portland, OR. 8p (CD ROM Publication)
- Heiduschke, A., B. Kasal, and P. Haller. 2006. Analysis of small-scale timber frames under earthquake loads. In Proceedings from the 9th World Conference on Timber Engineering. Portland, OR. 8p (CD ROM Publication)
- Heiduschke, A., B. Kasal, and P. Haller. 2006. Laminated timber frames under dynamic loading. In Proceedings of CIB W16 meeting. Florence, Italy. Universität Karlsruhe CIB W18
- Heiduschke, A., B. Kasal, and P. Haller. 2006. Analysis of wood-composite laminated frames under dynamic loads – analytical models and model validation. Part II: frame model. Progress in Structural Engineering and Materials. John Wiley & Sons Ltd. London. UK. Vol. 8. No 3. 111-119.
- Heiduschke, A., B. Kasal, and P. Haller. 2006. Analysis of wood-composite laminated frames under dynamic loads – analytical models and model validation. Part I: connection model. Progress in Structural Engineering and Materials. John Wiley & Sons Ltd. London. UK. Vol. 8 No 3. 103-110.
- Kasal, B., I. Peszlen, P. Peralta, L. Li. 2006. Test methods to evaluate the mechanical properties of genetically modified wood. In Proceedings from 7th World Conference on Computational Mechanics. Los Angeles, CA. July 2006.
- Kasal, B., Kloiber, M., Drdacky, M. 2006. Field investigation of the 14th century Castle Pernstejn before and after fire damage. In Proceedings from the 2006 Architectural Engineering Institute Conference. Omaha, NE.
- Heiduschke, A., P. Haller, and B. Kasal. 2006. Verbundsystem aus Stahlfaserbeton und Holz [in German]. In Proceedings from Forschungskolloquium Forschung + Praxis 2006. Institut für Konstruktion und Entwurf. University of Stuttgart. Stuttgart. Germany. February 23-34, 2006.

Other Activities

Industry Liaison – The PHRC works closely with various national, state and local groups to support efforts that are targeted at the housing industry. Groups and committees with which staff members of the PHRC have been involved include the following:

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 –Vice Chair for Research
- Building Environment and Thermal Envelope Council (BETEC)
- RILEM, Technical Committee Chair
- National Institute for Building Sciences (NIBS)
- U.S. Department of Energy, Peer review of building related research programs for the Build America Program
- Wood Engineering Achievement Award Committee (Bo Kasal-Chairman)
- International Council for Research and Innovation in Building and Construction – Working Commission W-18 – Timber Structures

Staff

Pennsylvania Housing Research Center

219 Sackett Building
 University Park, PA 16802
 Phone: (814) 865-2341
 Fax: (814) 863-7304
 E-mail: phrc@psu.edu

Bo Kasal	Director of Research	Phone: (814) 863-9788	E-mail: buk13@psu.edu
Mark Fortney	Director	Phone: (814) 863-2366	E-mail: mrf106@psu.edu
Alex Duran	Land Use & Development Specialist	Phone: (814) 863-2990	E-mail: aduran@enr.psu.edu
Mike Turns	Housing Program Dev. Specialist	Phone: (814) 863-0623	E-mail: mat289@psu.edu
Rhonda Decker	Administrative Assistant	Phone: (814) 865-7915	E-mail: rxd4@psu.edu
Tracy DeSoto	Staff Assistant	Phone: (814) 865-2341	E-mail: tsd5@psu.edu

Pennsylvania Housing Resource Center

Pennsylvania College of Technology

One College Avenue
 Williamsport, PA 17701
 Phone: (570) 327-4768
 Fax: (570) 320-5239
 E-mail: phrc@pct.edu

Bill Van der Meer	Director	Phone: (570) 327-4768 Ext. 3301	E-mail: bvanderm@pct.edu
Rick Terry	Director of Factory Built Housing	Phone: (570) 327-4768 Ext. 3322	E-mail: fterry@pct.edu