

# The Year in Review - 2005



## 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

**13<sup>th</sup> Annual PA Housing Conference** – The PHRC held the Annual Pennsylvania Housing Conference in two locations, Allentown and Pittsburgh. The Allentown conference was attended by 102 people on February 24 and the Pittsburgh conference was attended by 74 people on March 10<sup>th</sup>. The conference is the premier event for the housing industry in Pennsylvania and addresses emerging technical and policy issues.

The conference addressed these topics:

- |                                       |  |
|---------------------------------------|--|
| UCC Update                            | Common Code Violations & How to Avoid Them |
| Common Building Failures              | Visitability in Pennsylvania               |
| Flashing for Windows, Doors and Decks | Ventilation Drying in Wall                 |
| Concrete Performance                  |  |

## Pennsylvania Housing Research/Resource Center

Phone: (814) 865-2341  
Fax: (814) 863-7304  
e-mail: PHRC@psu.edu  
www.engr.psu.edu/phrc

The Pennsylvania State University  
219 Sackett Building  
University Park, PA 16802  
Director: Mark R. Fortney  
Director of Research: Bo Kasal

**Land Development Conference** – The Land Development Conference was held in conjunction with the PA Housing Conference in February and March 2005. At the Allentown, PA location, there were 76 attendees. The Pittsburgh, PA location had 42 attendees. The conference addressed these topics:

- |   |  |
|---|--|
| Legislative Update  | The Impact of Topography and Soils on Site Development   |
| Stormwater Management   | Infiltration: understanding the process and limitations  |
| Planning for Residential Developments...today's vision, tomorrow's trends | Soil Testing and Site Investigation...How much is enough |
| Lot Design...Thinking Outside the Box                                     | Panel Discussion—Site Selection and Infiltration         |
| Road Standards...optimizing for function and cost                         |  |

**Workshops and Training** – The PHRC provides a wide array of training, education and technology transfer services to builders, remodelors, building code officials, design professionals, teachers, home inspectors realtors, bankers and other professionals in the construction industry. Over 1,590 individuals participated in 79 workshops/seminars during 2005. The following is a summary of the formal training events we put on during 2005. For a full description of the workshops please visit [www.engr.psu.edu/phrc/workshops.htm](http://www.engr.psu.edu/phrc/workshops.htm).

<b>PHRC Training Programs Delivered</b>			
<b>PROGRAM</b>		<b>Activities for 1/1/05 – 12/31/05</b>	
		<b># of Programs</b>	<b># of Attendees</b>
Comprehensive IRC Program for Code Officials	CO1	10	192
Overview of the IRC's Plumbing Requirements for Code Officials	CO3	4	79
Overview of the IRC's Mechanical Requirements for Code Officials	CO4	5	106
PA's New Energy Requirements for Code Officials	CO5	3	63
Administering and Enforcing Pennsylvania's New Energy Code	CO5A	2	27
Commercial Energy Workshop for Code Officials	CO5C	4	87
Comprehensive IRC Program	GA1	2	62
Overview of the IRC's Mechanical Requirements	GA4	8	233
PA's New Energy Requirements	GA5	2	43
IRC Update Program	GA6	1	27
IBC Program for Concrete Masonry	MA2	8	247
Custom Programs	CP1	1	43
Stormwater Management in a New Age	SW2	1	55
Modular Housing Training Institute	MHTI	23	250
Manufactured Housing Resource Center	MHRC	5	76
<b>Total Programs Held</b>		<b>79</b>	<b>1,590</b>

The following is a discussion of program developments and changes:

– **2003-2006 IRC Update Program:**

The PHRC is in the process of developing a new program to help prepare builders, remodelors, design professionals and building code officials prepare for updating to the 2006 International Residential Code. By the end of 2006 the Pennsylvania Department of Labor and Industry anticipates to make the 2006 IRC the law in Pennsylvania.

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. The program will be available in July 2006.

– ***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

- ***Fundamentals of Concrete Masonry Requirements of the IBC Program:*** The PHRC developed a one-day training program for the Pennsylvania Concrete Masonry Association (PCMA) with support from the Educational Fund of the National Concrete Masonry Association (NCMA). The objective of the program was to provide architects, engineers, and building code officials an overview of masonry related requirements of the 2003 IBC and IECC. This includes general design considerations, fire safety, structural, thermal enclosure and common code violations as well as some of the changes between BOCA and IBC.

In 2005, this program was held in 8 locations across the Commonwealth to 233 individuals. This included a program held in conjunction with AIA of Pennsylvania's Annual Conference. The program was developed by a team of instructors which included Mark Fortney, Director of the PHRC, Dr. Walter Schneider PE, and Ned Liggett.

- ***PHFA HERS Program:*** The PHRC developed and administered a training event on home energy rating systems (HERS) for the Pennsylvania Housing Finance Agency. This was funded by the WPPSEF contract and registration fees. The program was held to educate applicants and design professionals on PHFA's initiative to provide additional credit on applications that incorporate a HERS of 86 or higher.
- ***Stormwater Management in a New Age: Understanding the Physical Processes and Analytical Tools***– This three day workshop was attended by 55 people in State College, PA on April 6, 7 and 8<sup>th</sup>. 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 DCED's Governor's Center for Local Government Services, the Pennsylvania State Association of Township Supervisors 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: ICC, PennBOC, CBO, PACO and Lancaster County Building Officials.
- ***PennDOT Training:*** The PHRC received a contract with PennDOT to deliver stormwater management training to Department Personnel based on the PHRC's April 2005 3-day Stormwater seminar.
- ***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 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. The PHRC held a train-the-trainer program in August in Valley Forge in partnership with multiple states in the Northeastern U.S. This program was developed under contract with the U.S. Department of Energy and delivered through the PCCA.

**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, E. Burnett, S. Brown and K. Sagan:

- *Roundtable on VisitAbility*, Pennsylvania Builders Association, March 2005
- *PHRC Research and Technology Transfer*, PA Concrete Masonry Association Board Meeting, April 2005
- *Overview of the PA Alternative Energy Provisions*, Blair County Builders Association, April 2005
- *Site Selection and Design to Minimize the Cost of Stormwater Management*, Pennsylvania Builders Association Board Meeting, State College PA, July 2005
- *The Impact of NPDES II on the Business of Stormwater Management*, American Society of Civil Engineers, Central Pennsylvania Section, Harrisburg, November 22, 2005 (35 in attendance)

**Web Site** – The PHRC continues to improve the web site ([www.engr.psu.edu/phrc](http://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 10<sup>th</sup>, June 30<sup>th</sup> and December 1<sup>st</sup>.

**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 the PA 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.

**Development of New NOCTI Tests** – The PHRC served on a peer review committee by the National Occupational Competency Testing Institute (NOCTI) to review their tests. One of their exams is given to students at the end of the school year in order evaluate the effectiveness of instruction and mastery of skills by students. Another test is intended for individuals who are entering the vocational teaching career. This test is required by the Commonwealth of Pennsylvania before an individual is permitted to teach. The review took place in August 2005.

**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**

---

**Simplified analysis of light-frame wood buildings under wind loads** - The objective of this research is to develop a simplified method that can be used to estimate the shear forces in shear walls of the LFWB so that more safe and efficient design can be achieved. This project is being funded by the USDA Forest Products Laboratory.

The expected outcome of the research is an analytical model that will permit more accurate estimate of reaction forces in the shear walls of the LFWB subjected to wind loads. A computer program was developed that will permit a static analysis of a rectangular building (one or two story) subjected to the wind pressures. This will permit more accurate design of the wind resisting elements within the LFWB and thus increase the safety and reduce the risks of potential future damage. Currently, the simulation results are being processed for publication.

**Property evaluation of genetically engineered wood from aspen with down-regulated lignin enzymes – mechanical properties** - The objective of this research is to develop, evaluate and apply the testing methodologies to evaluate the mechanical and viscoelastic properties of genetically improved material. The expected outcomes of the research will be values of mechanical properties of genetically improved material. The data will be useable to determine and study correlation between genetic markers and mechanical properties.

**Visitability** – The PHRC is participating in a project to review the costs and benefits of visitability guidelines in Pennsylvania. The PHFA funded project is a partnership between Life and Independence for Today and the PHRC. This project included the participation by six builders and 13 houses across Pennsylvania. The PHRC was responsible for conducting a technical and cost analysis of each house and developing viable design details.

**Ventilation drying of walls** – This is a follow up project to the ASHRAE and NSF funded projects that evaluated the contribution of ventilation drying to the performance of wall systems with screen type cladding, e.g., siding, masonry veneer, etc. The project was funded by the brick industry and included a series of laboratory tests and computer simulations to evaluate brick cladding systems. The final report has been submitted to the brick industry.

**Properties of wood composite materials and structural response of wood I-joists:** We have submitted five journal article manuscripts based on the work conducted by Dan Hindman for his Ph.D. program. The manuscripts report on the shear properties of composite wood products, the torsional rigidity of composite wood products and preliminary investigations of the lateral buckling behavior of composite wood rectangular and I-joist beams. Four of these manuscripts have been approved for publication and appeared in Wood and Fiber Science and in the Forest Products Journal in 2005. The fifth manuscript is under review. Dr. Hindman is now assistant professor of Wood Science and Engineering at Virginia Tech University. Graduate student, Mr. Jesse Burow, completed his laboratory work and his Master of Science thesis on the investigation of the allowable lateral buckling loads for composite wood I-joists. His research goal was to clarify issues with and improve the design specifications for the lateral buckling load for wood I-joists.

**Moment capacity of metal truss plate connectors** – We have completed the research project to measure the moment capacity for a wide range of metal truss plate connected truss joints. We submitted, and the sponsor (Truss Plate Institute) has accepted, the final report of our findings.

**Creep response of wood I-joist floor systems** – Two articles were published in the Transactions of ASAE in 2005 based on PHRC supported research efforts to measure the long term deflection of wood I-joist floor systems under dead plus sustained live loads. One article was published in the June/July issue of Structural Building Components.

### **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 2005:

- Ben Franklin Partnership
- Brick Industry Association
- Life and Independence for Today (LIFT)
- 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
- Dept. of Economic and Community Development
- Department of Environmental Protection (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 2005, the PHRC submitted 13 proposals totaling over \$1,500,000 to the following agencies:

- Ben Franklin Partnership
- Department of Economic and Community Development
- Department of Environmental Protection (Department of Energy)
- DCED Governor’s Center for Local Government Services (PSATS)
- National Science Foundation
- North Carolina State University (USDA)
- Pennsylvania Construction Code Academy
- PA Department of Transportation (PennDOT)
- Pennsylvania Energy Development Authority

- Water Environment Research Foundation (WERF)
- West Penn Power Sustainable Energy Fund (WPPSEF)

## Publications:

---

**Builder Brief** – The PHRC has completed the builder brief “Minimizing Corrosion Concerns When Using New Copper-based Pressure Treated Wood Products.”

Drdacky, M., B. Kasal, and S. Pospisil. 2005. Timber frames for high seismicity zones (in Czech). Inzenyrska Komora 2005. Drevene stavby. Special Publication of the Board of Registered Engineers of the Czech Republic. Prague. Publication No. 119. March 2005. 53-58.

Doudak, K., A. Ghallagher, B. Kasal, G. McClure, M. Mohammad, T. Stathopoulos, and I. Zisiz. 2005. Towards wind load paths on wood buildings. In Proceedings from the Fourth European & African Conference on Wind Engineering. Prague, July 2005 94-95. ISBN 80-86246-26-4.

Kasal, B., and R.J. Leichti. State of the art in multiaxial phenomenological failure criteria for wood members. Progress in Structural Engineering and Materials. John Wiley & Sons Ltd. London. UK. Vol. 6 No 1 January-March 2005.

Heiduschke, A., P. Haller, and B. Kasal. 2005. Seismic performance of moment-resisting frames with fiber reinforced and densified connections. In Proceedings from IABSE Symposium. International Association for Bridge and Structural Engineering. Lisbon.

Collins, M., B. Kasal, P. J. Paevere, and G. C. Foliente. 2005. Three-dimensional model of light-frame wood buildings. II: Experimental investigation and validation of analytical model. ASCE Journal of Structural Engineering. Vol 131. No. 4. 684-692.

Collins, M., B. Kasal, P. J. Paevere, and G. C. Foliente. 2005. Three-dimensional model of light-frame wood buildings. I: Model formulation. ASCE Journal of Structural Engineering. Vol 131. No. 4. 676-683.

Kasal, B., A. Heiduschke, I. Jirovsky, and S. Pospisil. 2005. Shake table experiments of full-size, 2-story laminated timber frame with fiber-reinforced connections. Paper No. 375. In Sixth European Conference on Structural Dynamics. EUROLYN 2005. Paris, France.

Kasal, B. 2005. Estimate of the design values of the in-situ wood structural members based on semi-destructive experiments. In Conservation of the Historic Wooden Structures. Florence, Italy. February 23-27. 2005.

## Other Activities

---

The PHRC delivered presentations at the following conferences:

- Burnett, E.F.P., “Cladding and Some Serviceability Issues,” *Presented at the Workshop on “Mitigating Housing Issues in Extreme National Events: 2005,”* sponsored by the Institute for catastrophic Loss Deduction and the University of Western Ontario, February 21, 2005, Toronto.
- Burnett, E.F.P., “9/11 and the Structural Hereafter,” *Presented at the ASCE Structure Congress*, April 24, 2005, New York, NY.
- Fortney, M., “When Building Codes and Building Science Conflict” *Affordable Comfort*, May 2005
- Fortney, M., DOE’s State Energy Code Conference, Austin TX, June 2005
- Fortney, M., “Building Energy Codes & Energy Efficiency” HUD’s Energy Symposium, Pittsburgh, PA, 8/2005
- Fortney, M., Building Science Symposium, Boston MA, August 2005
- Kasal, B., RILEM Board of Directors Meeting, Moscow, September 2005
- Kasal, B., “*Seismic Performance of Laminated Timber Frames*” EU Conference on Structural Dynamics, Paris, France, September 2005
- Fortney, M., Turns M., *LEED for Homes – Pilot Program Orientation*, September 2005

**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
- Building Environment and Thermal Envelope Council (BETEC)
- Forest Products Society, Wood Engineering Award Committee
- 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)
- Third International Building Physics Conference (Conference Committees)

**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

<b>Bo Kasal</b>	Director of Research	Phone: (814) 863-9788	E-mail: buk13@psu.edu
<b>Mark Fortney</b>	Director	Phone: (814) 863-2366	E-mail: mrf106@psu.edu
<b>Scott Brown</b>	Land Use & Development Specialist	Phone: (814) 863-2990	E-mail: sbrown@enr.psu.edu
<b>Mike Turns</b>	Housing Program Dev. Specialist	Phone: (814) 863-0623	E-mail: mat289@psu.edu
<b>Michelle McMullen</b>	Administrative Assistant	Phone: (814) 865-7915	E-mail: mlm3@psu.edu
<b>Tracy DeSoto</b>	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

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