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A New Era for the PHRC!**Introducing the New Hankin Chair of Residential Construction!**

The PHRC welcomes Dr. Ali Memari as the new Director of PHRC and Bernard and Henrietta Chair of Residential Construction. Dr. Memari has been teaching at Penn State



since 1995 as a Structural Engineering faculty. He holds B.S., M.Eng., and Ph.D. Civil Engineering degrees, respectively, from University of Houston, University of California, Berkeley, and Penn State University, and is a registered PE in Pennsylvania.

Dr. Memari has over 25 years of teaching and research experience, as well as several years of part time and full time consulting activities.

Dr. Memari's research over the past decade has concentrated on experimental evaluation of nonstructural building components and light-frame and masonry structural systems under different environmental and extreme natural events. Systems considered in previous studies have included window and glazing systems, veneer system, cladding panels, wood and steel stud walls, structural insulated panels, prefabricated foundation walls, various types of masonry wall systems, and air and vapor barriers. Recently, Dr. Memari has initiated some studies more specifically related to residential building construction systems such as modular construction, temporary housing, accessibility and mobility issues for people with disabilities, and energy performance

of windows. Dr. Memari's research in the past has been funded by government agencies, non-profit organizations, and the building industry. He is the author of over 160 publications, including papers in journals, conference proceedings, magazines, books/book chapters, and research reports. This year, Dr. Memari is also the president of ASCE's Architectural Engineering Institute.

A Message from the Associate Director

The PHRC is entering into an exciting new era with a new Director and Hankin Chair bringing a passion to the position, and beginning to increase the recognition of the PHRC in Pennsylvania, the nation, and abroad. Dr. Memari is revitalizing the PHRC's academic and applied research programs, and helping to guide students into housing-related careers.

The PHRC's industry-focused training and educational programs are also entering into a new era. With building codes not updating in Pennsylvania for the next several years, we will need to be more creative and aggressive to continue to meet the needs of the industry. I hope the newly developed, and in-progress, publications and educational programs described in this newsletter represent a strong step in that direction. In addition, I would like to encourage everyone reading this newsletter to tell a friend about the PHRC; encourage the organizations with which you are involved, to draw upon the PHRC as a resource by distributing our electronic publications, watching webinars as groups, and scheduling in-depth, face-to-face training programs.

I look forward to seeing you at our upcoming conferences, training programs, and other events.

– Mike Turns, Associate Director, PHRC

Conferences

1st Annual Residential Building Design & Construction Conference

This conference will be held in conjunction with the 21st Annual Pennsylvania Housing & Land Development Conference in Bethlehem, Pa., and is intended to provide a unique forum for researchers and practitioners to present findings and innovations related to residential buildings. A series of 15-minute technical sessions will be presented in two parallel tracks. Keynote speakers will include Sam Rashkin, Chief Architect for the US DOE's Building Technology Program, whose talk will be titled Money-Housing, and Richard Seifert, Professor Emeritus at the University of Alaska Fairbanks, whose talk will be titled, Thirty years in Dogged Pursuit of the Ultimate Superinsulated Passive Solar Home.

Attend this conference, or become a PHRC member, to receive a complimentary copy of the conference proceedings, which will include full papers describing the research upon which the conference presentations are based.

Visit our website for more information.

21st Annual PA Housing & Land Development Conference

Every year for the past 20 years, the PHRC has provided the commonwealth's premier networking and educational event



for the residential construction industry – and this year is no different. This conference discusses topics of more immediate and practical concern to industry professionals with some dirt under their fingernails. The keynote speaker will be

renowned industry expert, Gord Cook of Building Knowledge, Inc., as seen at events such as the NAHB's International Builders Show, Energy Design Conference, and JLC Live.

See the insert or visit our website for more information.

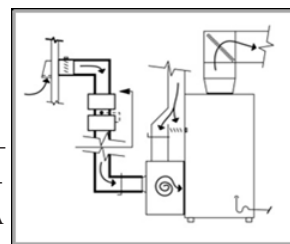
Project Update – Housing

New Builder Brief!

Kitchen Ventilation Systems : Providing Adequate Makeup Air

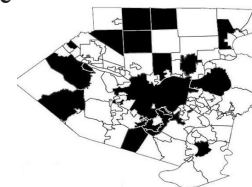
In April of this year, the PHRC released the second part of this two-part series. Part 1 – Evaluating the 2009 IRC Requirement for Makeup Air – found that, while seemingly arbitrary, the IRC's 400 cfm threshold for requiring makeup air actually makes sense. A house of code-level tightness may be depressurized by large exhaust systems to a level where dangerous appliance backdrafting is possible.

Part 2 – Providing Adequate Makeup Air – delves into three main types of makeup air systems and the pros and cons of each type. The simplest type, engineered openings, is probably not an acceptable solution for large range hoods as the pressure required to bring in outdoor air is above acceptable limits to reduce backdrafting risk. A better solution is an HVAC-integrated makeup air system with dampers interlocked to the range hood on/off switch. The third solution provides supplementary makeup air equipment to condition the incoming air to improve comfort and reduce loads on the central HVAC equipment. To read the full articles, visit: www.engr.psu.edu/phrc/Publications



Remodeler's Guide to Permits

In the coming year, look for the PHRC's Remodeler's Guide to Building Permits. This guide will consist of a primer on how the Uniform Construction Code applies, or does not apply, to renovations, repairs, and alterations to existing residential structures, followed by county-by-county maps indicating which municipalities have legal ordinances amending the UCC, and what those amendments regulate.



Exhaust Fan Performance

While building scientists continue to debate the appropriate levels of ventilation in single-family homes, there is near-consensus that, at some level of house tightness, builders should think about providing some amount of whole-house ventilation. The PHRC has embarked on a partnership with a Pennsylvania builder and Home Energy Rater to study the installed performance of whole-house and local exhaust systems. Preliminary results indicate high levels of variability of system performance with systems performing at as low as 37 percent of rated air flow to as high as 110 percent, with an average of 66 percent.



Builder Energy Case Studies

Do you or someone you know use innovative strategies to design and construct exceptionally energy efficient homes? If so, contact Mike Turns at mat289@psu.edu, or 814-863-2366 to tell your story.

Project Update — Land Development

New Logo for Land Dev. Pubs.

With an increasing number of land development activities and publications at the PHRC, we have created a new logo to help distinguish land development-focused publications from those focused strictly on housing structures and systems. Look for this logo on new publications.



New Development Briefs!

Land Development Process in Pa.

In September, the PHRC published its first land development brief, Summary of the Typical Residential Land Development Process in Pennsylvania. Permitting and approval agencies

don't always know the whole process of developing a piece of land, and are not always aware of the other permits or approvals that are needed to complete a project. This brief includes a short description of the land development process and shows a complex flow chart that integrates federal and state requirements, and provides a template for local requirements. The flowchart also includes a typical timeline for the various steps, based on agency review periods, which will allow for an easy comparison of the process in Pennsylvania with that of other states.

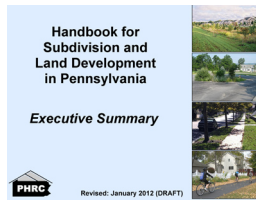
The International Stormwater BMP Database: Summary and Application for Design of Residential BMPs

In December, the PHRC published a two part series based on analysis of the stormwater data compiled in the International Stormwater Best Management Practices (BMP) Database maintained by the Water Environmental Research Foundation and American Society of Civil Engineers' Environmental Water Resources Institute. Part 1 of the series provides a summary of the Database and some general statements about types of BMPs that are good at removing particular pollutants. Part 2 of the series provides more detailed data analysis for use by stormwater design professionals. This brief includes pollutant percent removals for BMPs typically used in residential developments. Katie Blansett will be presenting a webinar on this topic on Tuesday, Feb. 12, 2013 at 1:00 PM. To read the full briefs, visit: www.engr.psu.edu/phrc/Publications



Handbook for Subdivision and Land Development in Pennsylvania

Work on the update and reformatting of the PHRCs' Handbook for Subdivision and Land Development in Pennsylvania will continue over the next year. Visit the PHRC website frequently to find updated booklets and webinar information as they become available.



Training Programs – New and Coming Soon! Contractor Recognition Training Series – New!

With signs that the housing market is picking back up, residential building professionals need to be prepared to hit the ground running. The PHRC has launched the Building Codes for Building Professionals series, consisting of 5 one-day courses covering 2009 IRC requirements for building, plumbing, mechanical, electrical, and energy Individuals who attend four of the five classes, and pass the short exams will receive a special certificate of completion to hang in their office or sales room!

Building with Exterior Rigid Foam – New!

Increasingly stringent energy codes, and heightened consumer expectations regarding energy efficiency and comfort, are causing more builders and remodelers to consider using exterior rigid foam. While the use of foam sheathing can result in a more efficient building enclosure, it is not without its practical hurdles. This program discusses window and door jamb extensions, flashing details, surface burning characteristics, siding attachment, wall bracing, and material selection.

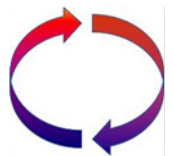


Online Training: The 2009 IECC for Residential Occupancies – Coming Soon!

This program marks the PHRC's first venture into self-paced online training. Based on an existing classroom-based course, this program will allow participants to learn about the energy code and earn continuing education credits without leaving home or the office. To be completed in early 2013, this program will be offered at no cost to the first 30 registrants, courtesy of a grant from the Pa. Dept. of Environmental Protection.

Intro to Building Science – Coming Soon!

Single-family homes are relatively simple structures, but the interactions between building materials, HVAC and exhaust equipment, appliances, occupants, climate and the movement of air, moisture, and heat can be surprisingly complex. This program will begin by explaining the basic physical principles that dictate the magnitude and direction of the flows of air, moisture, and heat. After gaining an understanding of those principles, participants will learn about how construction and occupant decisions affect building performance in terms of comfort, indoor air quality, durability, and energy efficiency.



Modular Training – Coming Soon!

This two-day program will be geared toward modular builders and set crews, with content based on input from modular plants. Topics covered will include site preparation, blueprint reading, dimensions and leveling, foundation preparation, worker safety, optimal scheduling, setting a modular home, finishing a modular home, and relevant code requirements. A special thanks to the Factory Built Housing Center at Penn College for developing the basis of this program!

Subs with Subs – Coming Soon!

In this program builders and remodelers will enjoy a submarine sandwich with their subcontractors, while learning about important flashing details and discussing who is responsible for them. Many callbacks result from water leakage resulting from the incorrect installation of flashing. Presenters will demonstrate proper flashing techniques through the use of hands-on models.

Tight Construction and Mechanical Ventilation – Coming soon!

Modern construction practices and energy code requirements have resulted in homes that are more air tight than in previous decades. This push for efficiency comes with the risk of compromising indoor air quality. This program will discuss common indoor air pollutants, the current thinking in ideal mechanical ventilation rates, and various options for providing whole-house ventilation. For a sneak peek at this program, check out our recorded webinar titled, Indoor Air Quality and Mechanical Ventilation in Tight Homes.

Contact Tracy at tsd5@psu.edu or 814-865-2341 for more information or to schedule a program!

Research Activities

Graduate Research

Dr. Memari is currently working with six graduate students on housing-related research projects. The outcomes of these research projects stand to benefit the housing industry, while preparing engineers to practice in housing-related fields. Topics of research include: 1) Evaluation of Vapor Barrier Membrane Performance under Seismic Induced Drifts; 2) Retrofit Methods for Energy Efficiency of Windows; 3) Evaluation of Structural Issues for Multi-story Modular Construction; 4) Development of Energy Efficient Window Systems; 5) Conceptual Developments and Feasibility of Multi-story Modular Construction; 6) Evaluation of Post-disaster Temporary Housing Systems.

Light Therapy Prototype

The goal of the project is to develop a working prototype of a residential living environment outfitted with a novel architectural lighting system designed to promote health by stimulating the human circadian system while maintaining standards for visual quality. The space will be instrumented with measurement devices to verify light exposure performance and will serve as a model for future research to promote senior health via light therapy.

Determination of Snow Loads

The ASCE-7 ground snow load table shows a significant portion of Pennsylvania shown as “CS”, indicating that a case study is required to determine the snow loads in that area. Over 60 percent of all PA municipalities have at least some of their land area in a CS zone. In such areas the selection of an appropriate snow load is left to the authority having jurisdiction. In most cases such authorities know little about snow loads. This project will consist of two phases. Phase 1 - Obtain the Army Cold Regions lab snow database and calculation spreadsheet, and beta test it. Phase 2 - Perform a comprehensive analysis of PA snow loads to determine the procedure and coordinate with PA structural engineers and builders.

Energy Performance of Windows

This study will evaluate the energy performance of various types of window systems available in the market, and create a rating of these systems in a side-by-side comparison. It will also identify various methods appropriate for retrofitting existing windows in order to improve the energy performance of such windows, and create a rating system for retrofits.



Training Programs

Course Title	Date	Location
Residential Plumbing Academy	January 7-10, 2013	Enola
IRC Building Code Refresher	January 9, 2013	Clarks Summit
IRC Electrical Code Refresher	January 15, 2013	Pittsburgh
IRC Electrical Code Refresher	January 31, 2013	Chester County
Residential Mechanical Academy	February 4-7, 2013	Enola
IRC Plumbing Code Refresher	February 5, 2013	Pittsburgh
IRC Building Code Refresher	February 13, 2013	Williamsport
PA House & Land Development Conference	February 20-21, 2013	Bethlehem
IECC for Commercial Occupancies	February 21, 2013	Bethlehem
Fire-Resistent Construction of Townhouses & Twins	February 21, 2013	Bethlehem
IRC Electrical Code Refresher	February 28, 2013	Wilkes-Barre
PCCA Symposium	March 6, 2013	Eastern PA
IECC for Commercial Occupancies	March 7, 2013	Delaware County
Residential Energy Academy	March 12-13, 2013	Enola
IRC Building Code Refresher	March 13, 2013	Ligonier
IRC Mechanical Code Refresher	March 13, 2013	Valley Forge
IRC Mechanical Code Refresher	March 14, 2013	Camp Hill
PCCA Symposium	March 20, 2013	Western PA
IECC for Commercial Occupancies	March 21, 2013	Allegheny County
IRC Plumbing Code Refresher	May 16, 2013	Allentown

Visit: <http://www.engr.psu.edu/phrc/Training/Workshops.htm>

Recorded Webinars

Date	Topic
November 13, 2012	Mechanical Ventilation in Tight Homes
September 11, 2012	Fire Protection of Floors - Demonstrating equivalence under Act 1
May 8, 2012	Makeup Air for Exhaust Systems in Tight Homes
April 10, 2012	How to Properly Install a Slab
March 13, 2012	Radiant Barriers: Do They Make Sense in Pennsylvania?
February 2012	No Webinar in February - Attend the 20th Anniversary PA Housing & Land Development Conference
January 10, 2012	Individual Lot Preparation: Consideration for Residential Construction

Upcoming Webinars

Date	Topic
January 8, 2013	Building Science Primer
February 12, 2013	The International Storm Water BMP Database for PA
March 12, 2013	Attic and Roof entilation -Facts & Fiction
April 9, 2013	HVAC Quality Installation - Code Requirements, Best Practices and Contractor Selection
May 14, 2013	High-Performance Wall Assemblies

For complete listing see: <http://www.engr.psu.edu/phrc/Training/Webinars.htm>

Hankin Distinguished Lecture Series Hankin Lecture 2012

Building Technology – Past, Present and Future was the subject of the 2012 Hankin Distinguished Lecture presented by Liza Bowles, Executive Director of Newport Partners, LLC, at the Nittany Lion Inn in State College. Ms. Bowles discussed the importance of innovation in the housing industry and reasons for lengthy delays in widespread adoption of innovative products. In Liza's words, when it comes to innovation, "you're never really done." The lecture was attended by over 170 students, faculty, and industry professionals. To watch a recording of the presentation, visit: www.engr.psu.edu/ce/divisions/residential/Hankin_lecture_series.html.

NAHB Student Residential Construction Management Competition

Each year during the International Builders' Show (IBS) the NAHB hosts the Student Chapter Residential Construction Management Competition (RCMC). Interdisciplinary teams from various universities participate in the competition that provides an opportunity for students to develop and present an investment proposal for a real-world residential development project. Last year, the Penn State NAHB Student Chapter placed 14th place among 35 universities.

This year's competition is to be held in Las Vegas from January 22 to 24, and the Penn State NAHB Student Chapter will send two teams. The teams

presented the draft of their projects to an audience of invited professionals during the NAHB Student Chapter Banquet on November 8, 2012. During this event, scholarships were presented to several NAHB Student Chapter students as well as travel scholarships for the two teams to compete at the IBS. Thanks to all our contributors!



PHRC's Industry Involvement Industry Advisory Council

One way the PHRC keeps its finger on the pulse of the housing industry is through meeting with our Industry Advisory Council. This council met in April to prioritize the PHRC's project goals for the 2012/13 fiscal year. The result being the applied projects, training programs, and select research projects discussed in this newsletter. The council met again in October to review progress and provide input. Consider becoming a Supporting or Leadership member of the PHRC (individually or as an organization) to receive an invitation to these meetings and help guide our activities.

PBA's PHRC Committee

As usual, this year the PHRC also received valuable industry input through quarterly meetings with the Pennsylvania Builder Association's PHRC Committee. PBA formed this committee as a mechanism for builders and other industry professionals to discuss the kinds of research and education the industry needs most. Ideas that come from these meetings are then presented at the PHRC's April Industry Advisory Council for discussion with a broader cross-section of the industry.

Manufactured and Industrialized Housing Advisory Groups

The PHRC also participates in biannual meetings of the Dept. of Community & Economic Development's Manufactured Housing Advisory Group and Industrialized (Modular) Housing Advisory Group. These meetings are a valuable opportunity for the PHRC to keep in touch with the concerns of the factory-built housing industry, and to offer input whenever possible. This year's meetings focused on the development of habitability and installation guidelines for relocated manufactured homes, as well as industrialized housing concerns like housing for natural gas drillers, shipping containers used as housing, and DCED's potential regulation of buildings greater than three stories in height.

PHRC Research and Testing Services

State-of-the-Art Research at the PHRC

The Penn State Architectural Engineering and Civil & Environmental Engineering Departments, within which the PHRC operations are based, feature a wide range of building research laboratories and facilities where research projects aimed at improving the quality of residential construction are conducted. Special emphasis is given to technical/engineering evaluations and analysis, computer modeling, and laboratory testing studies.

By providing laboratory testing services and engineering performance evaluation studies to product manufacturers, the PHRC fosters the development and commercialization of innovative technologies and supports code-conformance efforts. PHRC research and development services will ultimately benefit builders and remodelers in their efforts towards high performance building systems.

Flexible Laboratory Facilities

PHRC and affiliated labs have extensive facilities for the purpose of state-of-the-art building science research investigations and testing. These labs are unique in that all of their facilities allow flexible reconfiguration to support research and testing protocols beyond their normal function. We have the ability to design custom testing setups and protocols to evaluate alternative construction mock-ups. Testing facilities and equipment in the labs support structural, material property, thermal, weatherability, and indoor air quality investigations.

These facilities are fully computer controlled in order to accommodate a wide variety of tests and configurations.

Qualified Personnel

Lab personnel have participated in the process of converting custom laboratory methods to standardized test methods. The PHRC can integrate its activities with other testing labs to develop the most cost-effective solutions for client's research and testing needs.

Technical expertise has been developed in these labs to accommodate a wide range of research and standards-based testing relevant to the building industry, following standard methods and acceptance criteria established by AAMA, ANSI, APA, ASHRAE, ASTM, GSA, ICC-ES, ISO, NFRC, and others.

Building Product Systems Testing

These labs have experience evaluating conformance to standard specifications and testing building product individual components, built-up constructions, systems and technologies. Building products and systems comprised of composite materials, concrete, custom coatings and finishes, glass, insulating materials, masonry and mortars, metal, plastics, sealants, adhesives, stone, and wood can be tested in these facilities.

In addition to the custom facilities described on the following page, component testing facilities and equipment available to evaluate material properties of building components and built-up constructions as appropriate, such as tensile, compressive, flexural and shear strength, elongation, moduli, hardness, shrinkage, expansion, abrasion resistance, adhesion, cohesion, absorption, adsorption, cleanability, specific gravity, density, and composition.

Innovation to Support Industry

The PHRC can help residential building product manufacturers to develop appropriate field and laboratory assessments and investigations to assess building products and systems. We can work with the industry to develop strategies for gaining code compliance and approvals of unique and proprietary building products and systems. Moreover, we will follow quality assurance and quality control procedures necessary to gain acceptance of test reports that we prepare by accrediting agencies.

Our dissemination efforts can also be used to move the technologies we help to develop in the lab to mainstream acceptance through our participation in the process of developing design and construction guidance documents, code change proposals, acceptance criteria, and test standards and specifications.

A Snapshot of Available Laboratory Facilities

To test steady state thermal performance (R-value) of building components and systems according to ASTM standards, the PHRC affiliated laboratories now feature a Guarded Hot Box Facility. This insulated box is capable of testing specimens up to 6 ft. 6 in. by 3 ft. 8 in. with a maximum thickness of 9 in. High accuracy thermocouples, RTDs, and thermopiles are used to monitor surface and air temperatures, and additional sensors are used to measure specimen deflection and other air conditions. Facilities are also available to facilitate thermographic inspections.

Our large Climate Chamber simulates enclosure elements (e.g., portions of a wall or roof, or windows or sections of materials) under indoor and outdoor environmental conditions. Temperature, relative humidity and solar



radiation climate-condition profiles can be simulated with the facility. Within the Airflow Chamber, representative wall systems can be tested for ventilation. The Ventilation Drying Chamber replicates moist and dry outside air conditions on representative wall enclosure systems. We can simulate the effects of air pressure differentials, rain and temperature variations on material performance within our Enclosure Test Facility and Spray Rack.

Our Uniform Load Testing Facility uses various-sized custom “air bladders” to aid research on the effects of extreme wind, high pressure, and blast loading on envelope systems and building components. Computer-control of pressure within the air bladder allows for uniform high pressure loading to be applied to the system under test.

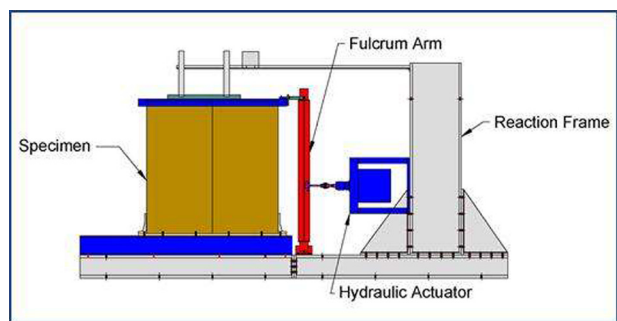


Our Dynamic Racking Facility simulates in-plane seismic loads up to 20 kips on different wall systems and building components. Cyclic loadings simulating seismic-induced, inter-story drifts of up to ± 6 inches are applied and sensor measurements and image analysis performed to allow detailed serviceability tracking of all system components under test.



The Light Shear Wall Loading Facility is capable of applying in-plane monotonic, static and cyclic loading, up to a capacity of 100 kips, to light shear walls. The main use of this facility is to test shear wall systems and building components under in-plane shear loading, based on different protocols or standards including ASTM E 72, ASTM E 560, and ASTM E 2126.

Evaluation of air leakage and air infiltration in accordance with ASTM and NFRC standards along with the evaluation of water infiltration, penetration and leakage in masonry and curtain wall systems in accordance with ASTM and AAMA standards is completed in our Air and Moisture Infiltration Testing Facilities. PHRC can help apply the results of air and moisture transport testing to building energy analysis.



Additional in-plane and out-of-plane shear load testing, the Strong Floor and Reaction Frame is capable of applying over 400 kips of cyclic lateral load to various wall, frame, and slab assemblies. This facility can also be configured to perform gravity load testing on different types of framing systems and prism tests on masonry systems. Displacement, strain, rotation, pressure, temperature and flow sensors are routinely used with the facility for evaluation of system under test movement and serviceability.



For More Information

For more information on any of these, or other PHRC facilities, and how the PHRC can meet your needs, please contact Dr. Ali Memari, Director of PHRC (memari@engr.psu.edu) or Paul Kremer, Research Associate and Manager of Laboratories within PHRC and the Department of Architectural Engineering (pakarc@engr.psu.edu).



FALL 2012
PHRC
NEWSLETTER

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PA Housing & Land Development Conference

February 20 - 21, 2013

The Sands Resort - Bethlehem, PA