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**The Pennsylvania Housing Research Center**

# **Project Plan**

## **July 2012 – June 2013**

Pennsylvania Housing Research Center  
Penn State University  
219 Sackett Building  
University Park, PA 16802  
Telephone: (814) 865-2341  
Facsimile: (814) 863-7304  
E-mail: [phrc.psu.edu](mailto:phrc.psu.edu)  
Web Site: [www.engr.psu.edu/phrc](http://www.engr.psu.edu/phrc)

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## Preface

Each year, the Pennsylvania Housing Research Center (PHRC) seeks to identify and prioritize a series of projects that collectively satisfy the following criteria. Projects should:

- meet the residential construction industry needs and the needs of the housing consumer in Pennsylvania;
- be consistent with the mission and goals of the PHRC;
- be affordable and feasible, given the resources available and the prevailing constraints on time, expertise and facilities; and
- be a balanced program of projects that address both the long- and the short-term needs of all sections of the industry.

This PHRC work plan is the result of input and assistance from numerous groups and individuals. The PHRC Industry Advisory Council (IAC) and the Operations Committee, in particular, have responsibility for the final choice of activities. These housing industry-based bodies consist of manufacturers, suppliers, builders, remodelers, industry associations as well as building code organizations and state agencies. On April 5, 2012 the IAC met to identify and discuss over 24 potential projects for the PHRC to pursue. After a thorough discourse, the members of the IAC voted on projects they felt were the highest priority for the industry. The IAC was also presented with, and approved, a Land Development Project Plan that was based on prioritization decisions made by the IAC Land Development Subcommittee during their meeting on March 22, 2012. Unless otherwise noted, the projects contained in this plan are anticipated to start July 1, 2012, and be completed on or before June 30, 2013.

The list of projects that follows identifies only those projects that are to receive funds provided to the PHRC by the Commonwealth of Pennsylvania. In most cases, we have attempted to use state funding to leverage outside support; in other cases the work is considered important enough to warrant full state support. It should also be recognized that the PHRC undertakes a wide array of additional projects that do not receive any of these funds and are therefore not listed in this plan.

Please note that with the collection of monies under Act 157 of 2006, there is not an accurate estimate of the exact amounts of funding available during this period. Because of this, this plan only considers funds in-hand. Any remaining funds will be carried over for future projects. We plan to continue with our previous initiatives in the areas of training and education, modular housing, manufactured housing, and applied research.

We plan projects and allocate funds at the start of each year. However, there is a real need for the PHRC to be able to take on special projects during the year. These projects typically fall into two categories: the first includes short term and limited scope projects that are time sensitive, while the second requires the ability to allocate some funds to leverage additional outside funds in response to requests for proposals.

For a description of PHRC Land Development activities for the 2012-2013 fiscal year, please see the companion document entitled, *Land Development Project Plan*.

# Housing Activities

## PART 1 - Training, Technical Assistance & Outreach:

The PHRC has a mandate to transfer knowledge by providing the necessary training and education to the wide variety of groups that make up the housing industry. The projects that are described below are in response to the recommendations that flow out of the PHRC's Industry Advisory Council and reflect the current needs within the housing industry.

### A. Program Development

**Description:** The PHRC will develop or update the following new training programs. These programs will address issues challenging the residential construction industry (builders, remodelers, building code officials, materials suppliers, etc.). During this period the following programs will be developed:

#### 1. PHRC Residential Building Scholar Series

In times of very tight competition, builders are frequently looking for ways to differentiate themselves from their competitors. The PHRC will offer builders a way to set themselves apart by recognizing individuals who complete the PHRC contractor educational series. Tentatively, the contractor educational series would consist of 5 one-day courses including IRC Building, Plumbing, Mechanical, Electrical and Energy. Contractors would have to demonstrate comprehension by passing an exam to be taken at the end of each class. Those individuals who attend four of the five classes and pass the exams within two years will be issued the PHRC Residential Building Scholar designation.

Existing PHRC training academy programs would be revised and condensed into one-day programs.

**Manager/PI:** Turns, Heitzmann

**Deliverables:** The PHRC will create 5 one-day programs and offer them at various locations around the commonwealth with a goal of 25 total programs held.

#### 2. Training for the Industrialized (Modular) Housing Industry

With the loss of funding of the Modular Housing Training Institute (MHTI) at Penn College, the PHRC will step in to provide training specifically targeted at the industrialized housing industry. 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.

**Manager/PI:** Turns, Heitzmann

**Deliverables:** A two-day training program to be delivered at least twice during the fiscal year.

### 3. Subs with Subs – A Focus on Moisture Control

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. A large percentage of construction issues result from water leakage, which can usually be blamed on the incorrect installation of flashing. Flashing is designed to prevent water infiltration by effectively protecting seams and joints in the water control area. This program, designed to educate builders, remodelers, and code officials, will focus on the problem areas on a home that require flashing, such as around windows and doors, step flashing at roof/wall intersections, in roof valleys, and around roof deck penetrations in order to properly seal critical seams. The goal will be to emphasize correct installation, which is critical in order to ensure that the home is leak free, thus preventing mold, wood rot and water damage that can result in costly repairs in the future.

**Manager/PI:** Turns

**Deliverables:** An approximately 90-minute interactive presentation will be developed and delivered at least four times.

### 4. Spray Foam Quality

Spray foam is becoming more and more common in the residential marketplace. Builders considering specifying spray foam should be aware of several potential foam quality and installations problems and understand how to avoid them. Application errors, off-ratio foam, and improper storage and shipping of spray foam materials can lead to shrinkage and cracking, or even catastrophic fires. This program will provide an overview of the benefits of spray foam, along with code requirements and proper storage and application techniques. This information is the key to selecting a subcontractor to get the job done right.

**Manager/PI:** Turns

**Deliverables:** A half-day program will be developed, piloted, and marketed. Additional programs will be delivered commensurate to demand.

### 5. Introduction to Building Science

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, the student will learn about how construction and occupant decisions affect building performance in terms of comfort, indoor air quality, durability, and energy efficiency.

**Manager/PI:** Turns

**Deliverables:** A one-day program will be developed, piloted, and marketed. Additional programs will be delivered commensurate to demand.

## 6. Tight Construction and Mechanical Ventilation

Modern construction practices and energy code requirements have resulted in homes that are more air tight than in previous decades. With these changes, builders and remodelers should more carefully consider introducing mechanical ventilation, including bathroom exhaust fans, range hoods (vented to the outside), and whole-house ventilation systems. This program will discuss how to determine ideal rates of mechanical ventilation to provide acceptable indoor air quality and removal of excessive moisture. It will also cover various options for providing mechanical ventilation.

**Manager/PI:** Turns

**Deliverables:** A half-day program will be developed, piloted, and marketed. Additional programs will be delivered commensurate to demand.

## B. PHRC Training Program Delivery

**Description:** The PHRC has developed and maintains a wide array of training for all sectors of the construction industry with a focus on residential construction. These programs are intended to address technical issues facing the industry. Additionally, the PHRC will customize programs to better meet the needs of an industry partner. Each program is developed with a particular audience, which may include builders, remodelers, trade contractors, design professionals, teachers, and building code officials.

The PHRC seeks to partner with relevant outside organizations whenever possible. These industry partners may include trade associations such as the Pennsylvania Builders Association or their 42 local associations, professional associations, building code associations, as well as the Pennsylvania Construction Code Academy (PCCA).

Current PHRC training program offerings are listed below. These are broken into three categories: (1) Residential Building Scholars, (2) Focused Topics, and (3) Academy Programs.

**Residential Building Scholars programs** are intended for those wishing to attain the RBS designation as described in Section 1 of this document. These programs are also well-suited for anyone interested in an introduction to building codes, a code refresher, an update from 2006 to 2009 IRC provisions, or information to make inspections go more smoothly.

**Focused Topics programs** are designed to immerse the student more deeply into a particular aspect of construction. These programs are ideal for meeting continuing education requirements for RBS designees and certified code officials.

**Academy Programs** are typically offered twice per year through the Pennsylvania Construction Codes Academy (PCCA). These programs are geared toward beginning code officials seeking to pass their certification exams, or anyone interested in a comprehensive overview of residential building codes.

For program descriptions, please visit [www.engr.psu.edu/Training/ScheduleWorkshop.htm](http://www.engr.psu.edu/Training/ScheduleWorkshop.htm).

- |   |             |
|---|-------------|
| 1. Residential Building Scholars Programs                         |             |
| a. IRC Building   | 1 day       |
| b. IRC Plumbing   | 1 day       |
| c. IRC Mechanical   | 1 day       |
| d. IRC Electrical   | 1 day       |
| e. Residential Energy Codes                                       | 1 day       |
| 2. Focused topics   |             |
| a. Advanced Framing – Increasing Performance and Reducing Costs   | ½ day       |
| b. Beginner’s Blueprint Reading                                   | 1 day       |
| c. Building with Exterior Rigid Foam                              | ½ day       |
| d. Exterior Plaster Finish Systems                                | ½ day       |
| e. International Residential Code Inspections                     | 2 day       |
| f. Photovoltaic Installation and Inspection                       | 1 day       |
| g. Residential Deck Design and Construction                       | 1 day       |
| h. Residential Fire Sprinklers                                    | 1 day/2 day |
| i. Solar Hot Water Installation and Inspection                    | 1 day       |
| j. Special Issues with Two-Family Dwellings and Townhouses        | 1 day       |
| 3. Academy Programs (available through PCCA only)                 |             |
| a. International Residential Code – Building Essentials           | 4 day       |
| b. International Residential Code – Plumbing Essentials           | 4 day       |
| c. International Residential Code – Mechanical Essentials         | 4 day       |
| d. International Residential Code – Electrical Essentials         | 4 day       |
| e. Residential Energy Code Essentials                             | 2 day       |
| f. International Energy Conservation Code Essentials – Commercial | 2 day       |

**Manager/PI:** Turns, Heitzmann

**Deliverable:** The PHRC will deliver at least 30 workshops to be held across the commonwealth.

## C. Web-Based Training

**Description:** The PHRC will continue its successful monthly webinar series, and possibly expand further into the realm of more in-depth online training. In today’s economic climate, there is a need for technical programs without the added cost of hotels and transportation.

### A. Self-Paced Online Training

Expansion of the PHRC’s online training resources is contingent on the success of the pilot program, which will be rolled out during the summer of 2012. If that program is well-utilized, other PHRC training materials will be converted into the online format.

**Manager/PI:** Turns

**Deliverables:** At least one self-paced, online training program will be developed, advertized, and the number of participants tracked (contingent on a successful pilot program).

## B. Webinars

Webinars are delivered live, and are also archived for on-demand viewing. Proposed topics are listed below.

Housing Webinar Series	
Month	Proposed Title/Topic
September	Fire Protection of Lightweight Floor Systems – Demonstrating Equivalence
October	The Not So Big House Concept
November	Mechanical Ventilation in Tight Homes
December	Spray Foam – Code Requirements and Quality Installations
January	Building Science Primer
February	No webinar – attend PA Housing and Land Development Conference
March	Attic and Roof Ventilation – Facts and Fiction
April	HVAC Quality Installation – Code Requirements, Best Practices, and Contractor Selection
May	High-Performance Wall Assemblies

Programs are subject to change and additional programs may be added to address industry demands and emerging issues.

**Manager/PI:** Turns, Heitzmann

**Deliverable:** The PHRC will develop and deliver at least eight housing webinars. Additional programs may be added to address emerging issues as they arise.

## D. Builder Briefs

**Description:** The PHRC will continue its series of short technical documents that address specific issues that have been identified by builders or remodelers. These documents are intended to be quick to read with a lot of the information presented graphically or pictorially. Potential topics include:

1. Exhaust fan performance in tight homes
2. Energy performance of various window systems

**Manager/PI:** Turns, Memari, Heitzmann

**Deliverable:** At least two Builder Briefs will be researched, written, printed and distributed.

## E. Technical Assistance, Technology Transfer & Outreach

**Description:** This item is a continuation or expansion of activities to get information and publications to builders, remodelers, design professionals, building code officials and others involved in the residential construction industry.

**Manager/PI:** Turns, Blansett, Heitzmann

**Deliverables:** The PHRC will work with the PBA and other industry and trade organizations by means of the following activities:

1. **Annual Pennsylvania Housing and Land Development Conference:** For 20 years this conference has been the premier technical conference for housing and land development issues in Pennsylvania. This two-day conference provides the latest information on emerging technologies and how to resolve problems facing the housing industry. The conference is intended for all sections of the housing industry including builders, remodelers, code officials, educators, design professionals and modular and HUD-code builders. One day of the conference focuses primarily on the house itself, while the other serves as an annual forum that addresses emerging planning, design, and regulatory issues affecting the land development industry in Pennsylvania. This day is intended for anyone involved in land development activities including builders, developers, design professionals, planners and regulatory officials.
2. **PCCA Symposium:** The PHRC will work with the PCCA to develop and deliver a one-day program that will be drawn from the content of the Pennsylvania Housing and Land Development Conference. This annual event is intended to address technical issues being faced by building code officials.
3. **Speaker Service:** The PHRC will hold and/or participate in talks and seminars directed at the housing and land development industries. This may include trade and professional association functions and regional meetings, local association meetings, or state or national conferences.
4. **General Outreach Activities:** This includes activities to let builders know about the PHRC and the services and publications it provides. These activities may include the PHRC newsletters, mailings, promotional pamphlets, advertisements in trade journals, phone calls, and the PHRC's Web site.
5. **Fall Newsletter** – This letter will be sent to PHRC members to keep them up-to-date on recent PHRC activities, and promote upcoming events including the PA Housing and Land Development conferences.

## PART 2 - Applied Research

A very important function of the PHRC is to undertake or stimulate research and development on materials, products, procedures, and processes. These efforts may have a longer-term or a more fundamental focus than other projects. The projects that are listed below foster partnerships and draw on the expertise and strengths of the persons, groups and facilities available at both the Pennsylvania State University and the Pennsylvania College of Technology.

### A. Energy Performance of Window Systems

**Description:** 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.

**Manager/PI:** Dr. Ali Memari

**Deliverables:** This project will produce a short technical report.

## B. Prototype Architectural Light Therapy System

**Description:** 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 clinical trials and larger-scale residential installations. This project fosters the research/industry partnership that was a founding goal of the center. The PHRC wishes to encourage the relationship between Penn State faculty and its industry partners in order to stay on the cutting edge of housing-related research. Note: This project is being carried over from the previous project plan because of loss of key personnel last year.

**Manager/PI:** Dr. Richard Behr

**Deliverables:**

1. A fully equipped and calibrated prototype *Architectural Light Therapy System* will be designed and constructed on the Penn State University Park campus.
2. A journal-quality research paper describing the design and calibration of the *Architectural Light Therapy System* will be written and submitted for peer review.
3. A major research proposal will be written and submitted to an external funding agency (e.g., National Science Foundation, National Institutes of Health, etc.) to perform a large-scale clinical trial of the effectiveness of the space in maintaining and promoting senior health.

## PART 3 - Applied Projects

These groups of projects are application oriented and have a direct need by the residential construction industry. This includes the development and support of standards, and longer term initiatives.

### A. Determination of Unspecified Snow Loads

**Description:** 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% 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 with AE faculty and/or AE 537 students using PA sites. Phase 2 - Perform a comprehensive analysis of PA snow loads using an MS student to determine the procedure and coordinate with PA structural engineers and builders.

**Manager/PI:** Turns

**Deliverable:** This project will result in a research report, and a revised snow loads map with more comprehensive coverage of Pennsylvania municipalities.

## **B. Builder Energy Case Studies**

**Description:** This project will spotlight several builders who are using advanced techniques and materials to achieve above-code levels of energy performance. An article or series of articles will describe the techniques and materials used in several homes, and compare the energy performance of those homes with typical homes, using utility data if possible.

**Manager/PI:** Turns

**Deliverable:** An article, or series of articles, to be published online.

## **C. A Remodeler's Guide to Building Permits in Pennsylvania**

**Description:** This guide would 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 of municipalities indicating which municipalities have legal ordinances amending the UCC.

**Manager/PI:** Turns

**Deliverable:** A short guide to the UCC's applicability to existing residential structures, and 67 county maps indicating presence or absence of municipal amendments.

## **D. Exhaust Fan Performance in Tight Homes**

**Description:** Exhaust fans do not always perform at their labeled exhaust rate. This may be the result of poor duct design and installation, and high levels of house tightness with inadequate makeup air. This project will consist of a case study of fan performance in roughly 30 homes built by a major Pennsylvania builder. Flow rates of exhaust fans installed in tight homes will be measured and compared with the fan's rated CFM. This project will also detail energy consumption ratings of various fan motors, and provide a range of estimated annual electricity consumption and costs, assuming ASHRAE 62.2 minimum ventilation rates.

**Manager/PI:** Turns

**Deliverable:** A builder brief discussing the background and findings of the case study.

## **E. Support of Standards**

**Description:** The PHRC has developed three standards to respond to industry demand. These include Pennsylvania's Alternative Residential Energy Provisions, Pennsylvania Standards for Residential Site Development Standards and Foundation Systems for Relocated Manufactured Housing. Each of these standards requires training and timely technical assistance for local governments, builders/developers, design professionals, and contractors. All of these standards are available electronically for free and hard copies are available for a fee.

**Manager/PI:** Turns

**Deliverable:**

1. Pennsylvania's Alternative Residential Energy Provisions - 2009: Education will be provided through various building code training programs and technical assistance will be provided through telephone and email support by the PHRC.
2. Pennsylvania Standards for Residential Site Development Standards: Please see the Land Development section.

3. Foundation Systems for Relocated Manufactured Housing: The PHRC will provide technical assistance through telephone and email support.

## PART 4 - Contingency Projects

The PHRC may take on high priority, short-term projects mid-cycle as opportunities arise. Some issues and project ideas arise after the spring Industry Advisory Council (IAC) planning meeting, yet are important topics to address. Other project ideas were brought to the IAC, but lacked sufficient outside financial support or staffing at the time this plan was issued. Below are several projects that may be undertaken contingent upon receiving additional funding and personnel.

### A. Market Value of Home Energy Efficiency

**Description:** Advocates of increasingly stringent energy codes and above-code programs like Energy Star Homes purport various benefits to homeowners like lower energy bills and increased comfort. But are these benefits recognized in the sales price of a home, and if so, by how much? Much of the research is between 10 and 30 years old making it difficult to draw conclusions about today's market. This project would compare the sales prices homes of various energy efficiencies while controlling for confounding variables. This project is contingent upon data availability and the ability of the PHRC to partner with financial experts.

**Potential deliverable:** This project would result in a short research report.

## Projected Budget by Project Categories

Project	Act 157 Funds	Outside <sup>1,2</sup>	PSU Support	Total
Training, Technical Assistance and Outreach	\$181,310	\$288,318	\$88,842	\$558,470
Applied Research	\$162,671	\$14,000	\$79,709	\$256,380
Land Development	\$105,709	--	\$51,797	\$157,506
Applied Projects	\$71,384	--	\$34,978	\$106,362
Total	\$521,074	\$302,318	\$255,326	\$1,078,718

Notes:

- 1 Outside funding is received from a variety of sources including fees for services, in-kind contributions, industry contributions, grants and contracts.
- 2 These funds are contingent upon industry commitments.