



The Pennsylvania Housing Research Center

Project Plan

July 2014 – June 2015

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@engr.psu.edu

Web Site: www.engr.psu.edu/phrc

Table of Contents

Preface	1
PART 1 - Training, Technical Assistance & Outreach	2
A. Program Development	2
1. Existing Program Update & Maintenance.....	2
2. Expand ½-day Stucco Program to Full Day	2
3. 2015 IRC Sneak Peak	3
4. Mock-up Based Training: Step Flashing Assembly	3
5. Land Development Education and Training of Associated Partners.....	3
6. Revised Stormwater BMP Manual Training	4
7. Educating the Next Generation of Tradespeople.....	4
B. PHRC Training Program Delivery.....	4
C. Web-Based Training	6
D. Builder Briefs.....	6
E. Technical Assistance, Technology Transfer & Outreach.....	7
PART 2 - Applied Research	8
1. Evaluation of Wall Insulation Retrofit Options for Existing Homes	9
2. Passive Cooling Opportunities for Seasonal Energy Savings in Mass-Produced Homes	9
3. Shear Wall Opportunities in Residential Construction.....	10
PART 3 - Applied Projects	11
1. Details that Work: Foundations and Passive Radon Systems	11
2. Crawlspace	11
3. Insulation Modeling and Durability Assessment.....	12
4. Stucco: Code Review/Analysis and State of the Art Report	12
5. The Fundamentals of Indoor Air Quality in Residential Buildings.....	12
6. Support of the UCC RAC.....	12
7. Support of Standards	13
PART 4 - Contingency Projects	13
1. Determination of Unspecified Snow Loads.....	13
2. Stormwater BMP Effectiveness in Real Residential Developments	14
Projected Budget by Project Categories	15

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 project plan is the result of assistance and input from numerous groups and individuals. The PHRC Industry Advisory Council (IAC), in particular, has responsibility for the final choice of activities. This housing industry-based body consists of builders, developers, manufacturers, suppliers, remodelers, design professionals, industry associations as well as building code organizations and state agencies.

On April 10, 2014 the IAC met to discuss over 31 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. This voting resulted in a prioritization of projects. The high-priority projects are included in this plan. 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 27, 2014. The land development related projects are included in this project plan.

Unless otherwise noted, the projects contained in this plan are anticipated to start July 1, 2014, and be completed on or before June 30, 2015.

The list of projects that follows identifies only those projects that are to receive funds provided to the PHRC by the Commonwealth of Pennsylvania. The PHRC attempts to use Commonwealth 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 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, the current plan only considers funds in-hand, funds collected from July 2013 to June 2014.

The PHRC plans projects and allocates 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.

In June of 2014, at the time of the development of the PHRC Project Plan for the fiscal year of July 2014 to June 2015, there is a piece of legislation in the Pennsylvania General Assembly that would amend Act 157 of 2006 and could potentially change the allocations of funds collected through the permit fees. A reallocation of permit fee monies would reduce the funds available for PHRC projects. The PHRC may need to adjust the proposed projects or the registration fees for programs to accommodate changes in funding.

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 from the PHRC's Industry Advisory Council and reflect the current needs within the housing industry.

A. Program Development

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

1. Existing Program Update & Maintenance

Description: Some of the PHRC's existing training programs are starting to show their age and technology, as well as educational pedagogy, have progressed quite a bit since the early programs were first developed. This project will involve an organized effort to give the most-delivered existing programs a face lift. Much of the focus in the update will be to improve the photos in programs, incorporate more photos or videos as appropriate, and expand active learning exercises to increase learner participation and knowledge retention. This project will also include the beginning of a focused effort to provide more training programs online.

Manager/PI: K. Blansett

2. Expand ½-day Stucco Program to Full Day

Description: The PHRC has an existing half-day training program on "Stucco & Adhered Masonry Veneer". In light of the recent increase in stucco failures related to moisture intrusion, this ½-day program will be expanded to a full-day program to include a discussion of the lessons learned from these failures, as well as, more in-depth detail on wall assemblies and flashing details. This discussion will also incorporate a fundamental discussion of building science concepts necessary for understanding the transport of moisture through these exterior wall systems.

Manager/PI: B. Wolfgang

3. 2015 IRC Sneak Peak

Description: The most recent triennial codes including the 2015 International Residential Codes (IRC) have just been published in June of 2014. Builders, code officials, designers, municipal officials, state government officials, construction-industry professionals, and the general public need to be educated on the new code provisions contained in the latest version of the IRC. This education will help allow attendees to formulate and present their viewpoints regarding potential IRC changes at public hearings of the UCC Review and Advisory Council as well as other venues. This training program will also aid stakeholders in preparing for possible code changes that could be adopted.

Manager/PI: B. Heitzmann

4. Mock-up Based Training: Step Flashing Assembly

Description: In the 2012-2013 project year, the PHRC piloted the first mock-up based training on the topic of exterior moisture management. This project was originally called “Subs with Subs” with the idea of taking a training program to a work site and meet with subcontractors. The program included a demonstration of proper window flashing details and quickly became one of the more popular PHRC programs. Expanding on the success of the flashing model, the PHRC developed a mock-up based program on air barriers during the 2013-2014 project year using external funding. This short-training program again showed great success. Because of the popularity of these mock-up based programs, the PHRC will incorporate a new mock-up based training each year to visually demonstrate a construction or installation issue. Each year’s topic will be based on an industry-identified construction issue. The mock-up for the 2014-2015 project year will be a roof/wall intersection step flashing assembly.

Manager/PI: C. Hine

5. Land Development Education and Training of Associated Partners

Description: This project will focus on providing education on environmental regulations and land development related topics to a nontraditional audience for the PHRC including realtors, commercial bankers, attorneys, etc. (“Associated Partners”). These Associated Partners are intimately involved with the land development process but may not be working as closely with recent regulatory changes. All players in the process need to understand these regulations to ensure that the process moves as smoothly and quickly as possible. This project will include writing newsletter articles for relevant professional publications and speaking at relevant meeting/conferences such as realtors’ conferences or chamber of commerce meetings.

Manager/PI: K. Blansett

6. Revised Stormwater BMP Manual Training

Description: Dr. Blansett has been working with the Pennsylvania Stormwater Technical Workgroup (PaSTW) to develop a new stormwater BMP manual for Pennsylvania. The revised stormwater manual will provide additional tools and options for stormwater designers and support the land development process. As the project progresses, the Pennsylvania Department of Environmental Protection (PADEP) will need assistance in the development and delivery of training on the revised manual. This PHRC project will allow Dr. Blansett to contribute her expertise to the development and delivery of training on the new stormwater manual to help ensure that the project is able to move forward and be implemented.

Manager/PI: K. Blansett

7. Educating the Next Generation of Tradespeople

Description: Educating the “next generation” of residential trade contractors is essential for the future of residential construction. With the support of the IAC, the PHRC will consider the education of the next generation of tradespeople as an ongoing project. The ultimate goal is to increase the detailed knowledge of future industry tradespeople through this general outreach and provide students with professional development opportunities within the residential construction industry. This project will include relationship building, sharing of resources, speaker services at schools, leveraging resources and contacts to bring opportunities to students, and getting feedback from instructors and administrators to better address their needs. Other outreach activities will include trying to increase participation of vocational students and instructors in the PHRC conference, PCCA Symposia, and PHRC webinars. The PHRC will also pursue the accreditation through the Pennsylvania Department of Education to offer continuing education credit to secondary school instructor. The PHRC will establish a scholarship program to allow more students to attend the Annual PHRC Housing and Land Development Conference.

Manager/PI: K. Blansett

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. The intended audience for these programs includes builders, remodelers, trade contractors, design professionals, teachers, and building code officials. Additionally, the PHRC can customize programs to better meet the needs of an industry partner.

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 Scholar/ Residential Code Scholar/Code Refresher, (2) Focused Topics, and (3) Academy Programs.

(1) **Residential Building Scholar (RBS)/Residential Code Scholar (RCS)/Code Refresher** programs are intended for those wishing to attain the RBS or RCS designation. These 1-day programs are a shorter alternative to the multi-day academies and are also well-suited for anyone interested in an introduction to building codes, an update from 2006 to 2009 IRC provisions, or information to make inspections go more smoothly. The RBS program was established as part of the 2012-2013 project plan.

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

- | | |
|---|----------|
| a. Advanced Framing – Increasing Performance & Reducing Costs | ½ day |
| b. Beginner’s Blueprint Reading | 1 day |
| c. Building with Exterior Rigid Foam | ½ day |
| d. International Residential Code Inspections | 2 day |
| e. Photovoltaic Installation and Inspection | 1 day |
| f. Residential Deck Design and Construction | 1 day |
| g. Residential Fire Sprinklers | 1, 2 day |
| h. Solar Hot Water Installation and Inspection | 1 day |
| i. Special Issues with Two-Family Dwellings and Townhouses | 1 day |
| j. Stucco & Adhered Masonry Veneer | ½, 1 day |
| k. Energy Plan Review and Inspection | 1 day |
| l. Basement Essentials 101 | online |
| m. High-Performance, Code Compliant HVAC Systems | varies |
| n. Land Development Process | 2 hour |
| o. Stormwater 101 | 2 hour |
| p. Building Science | ½, 1 day |
| q. Building Code Plan Review and Inspection | 1 day |

(3) **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.

- | | |
|---|-------|
| 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

For program descriptions, visit

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

Manager/PI: K. Blansett

C. Web-Based Training

Description: In today’s economic climate, there is a need for technical programs without the added cost of hotel stays and transportation. Based on this the PHRC will continue its successful monthly webinar series. Webinars are delivered live, and are also archived for on-demand viewing. Proposed topics are listed below. One certification maintenance credit is offered for each webinar for PA code officials. As appropriate, AIA Learning Units (LUs) for architects and professional development hour (PDHs) for engineers and land surveyors will be offered.

2014-2015 Webinar Series

Month	Proposed Title/Topic
Sept	Requirements for Fire Protection of Light Weight Floor Systems
Oct	Insulating with Exterior Rigid Foam
Nov	The Appraisal Process
Dec	Fundamentals of Stucco and Manufactured Stone Claddings
Jan	Aging-in-Place, Part 1
Feb	No webinar – Attend PA Housing and Land Development Conference
March	Aging-in-Place, Part 2
April	The Do’s and Don’ts of the Design and Construction Regarding Crawlspace
May	Thermal Bridging in Residential Construction

As part of the land development initiatives, a webinar on the topic of “Soil Considerations for Stormwater BMPs” will also be developed and delivered in the spring of 2015.

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

Manager/PI: B. Heitzmann

Deliverable: The PHRC will develop and deliver at least eight 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 called Builder Briefs 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:

- Crawlspace
- Insulation Modeling and Durability
- Indoor Air Quality

- Evaluation of Wall Insulation Retrofit Options for Existing Homes
- Passive Cooling Opportunities for Seasonal Energy Savings in Mass-Produced Homes
- Shear Wall Opportunities in Residential Construction

Manager/PI: K. Blansett

Deliverable: Builder Briefs will be researched, written, printed and distributed.

E. Technical Assistance, Technology Transfer & Outreach

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

Manager/PI: K. Blansett

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 22 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. The Housing Day of the conference focuses primarily on the house itself, while the Land Development Day serves as an annual forum that addresses emerging planning, design, and regulatory issues affecting the land development industry in Pennsylvania. For the 2015 Conference, the PHRC intends to include a third session of the PCCA Symposium in conjunction with the Annual conference.
- 2. PCCA Symposium:** The PHRC will work with the PCCA to develop and deliver 3 one-day programs (one in the central region of the Commonwealth in conjunction with the PHRC Annual Housing and Land Development Conference, one in the eastern part of the Commonwealth, and one in the western part). 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, seminars, and conferences 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. Speaker service topics include:
 - UCC Overview/update
 - Floor Fire Protection
 - Exterior Water Management
 - PA Alternative Residential Energy Provisions
 - Foundation Systems for Relocated Manufactured Housing

- Subdivision and Land Development Guidelines
 - Stormwater 101
 - Intro to WQ Calculations
 - Land Development Process
 - Stormwater Management Concerns in Karst Regions
 - Insulation: Is this “stuff” right?
 - Code Compliant Air Barriers: It’s All About Continuity
4. **General Outreach Activities:** This initiative includes activities to keep industry professional up-to-date on technical issues, as well as, informed on the services and publications the PHRC provides. These activities may include the PHRC newsletters, mailings, promotional pamphlets, articles in trade journals, phone calls, and the PHRC’s website.

This also involves attending relevant industry meetings, such as the Pennsylvania Department of Environmental Protection (DEP) meetings (Water Resources Advisory Council, Sewage Advisory Council); participating in technical committees such as the Pennsylvania Stormwater Technical Workgroup; and serving as a technical resource to legislative committees as needed

Pennsylvania Stormwater Technical Workgroup. As part of outreach activities, Dr. Blansett will continue to serve on the Executive Board of the Pennsylvania Stormwater Technical Workgroup (PaSTW). She serves as the chair of the Low Impact Development Committee (Chapter 5) and as a member of the Land Development Process Committee (Chapter 4). PaSTW is working to revise the DEP PA Stormwater BMP Manual.

5. **Annual Newsletter** – The PHRC Annual Newsletter will be sent to PHRC members to keep them up-to-date on recent PHRC activities and promote upcoming events. In the past, the newsletter has been sent in January. For the 2014-2015 project year, the PHRC intends to change the newsletter schedule to be delivered in the late summer or early fall to provide more timely updating of the audience with the outcome of the previous year’s projects and what to expect in the coming year.

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 the Pennsylvania State University.

1. Evaluation of Wall Insulation Retrofit Options for Existing Homes

According to the 2011 DOE Building energy Data Book, the energy consumption breakdown for the residential building enclosure is as follows: Roofs: 1.00 Quads, Walls: 1.54 Quads, Foundation: 1.17 Quads, Infiltration: 2.26 Quads, and windows (conduction): 2.06 Quads, a Quad is defined as 1015 BTU. Because of the great heat loss through windows, there has been significant development in new energy efficient window systems. The next component that has also been focused on is the insulation types for new construction. Currently, various insulation materials have been developed to offer options beyond traditional fiberglass batt insulation. These options include various types of loose insulation materials, different rigid insulation boards, foam insulation, sandwich boards of vapor barrier and rigid insulation, sandwich boards of sheathing and rigid insulation, etc. Most of these products are suitable for new construction. However, information and understanding about the suitability and appropriateness of different insulation systems for retrofit purposes is not readily available. The thought of the expense to tear down drywall or exterior sheathing to add insulation has not encouraged such retrofit projects.

Nonetheless, because the issue is of great importance to reduce energy loss in existing homes through walls with poor insulation, it is proposed that a project be undertaken to look into all possible methods and materials/components suitable for retrofitting existing walls to enhance energy efficiency. In the process, some new ideas can be developed as well and suggested to the industry. Each method will be evaluated for energy saving enhancement through modeling using available software such as a combination of THERM, WINDOW and Energy 10, which can provide energy performance of a typical home with retrofitted wall as compared with a standard baseline wall system. The potential condensation issues will also be studied by using software such as WUFI. The study will also develop a cost analysis for each option so that various retrofit methods can be compared for energy consumption as well as retrofit cost and payback period.

Manager/PI: Dr. Ali Memari

Deliverables: The project will deliver a final report, a paper for the Residential Building Design and Construction Conference, and likely a journal paper.

2. Passive Cooling Opportunities for Seasonal Energy Savings in Mass-Produced Homes

Over the last several decades construction practices of contemporary residential structures have improved significantly resulting in good energy performance. The building envelopes are properly insulated, windows are carefully chosen for their resistance to heat flow, gaps in construction are meticulously sealed, and the heating and cooling equipment is selected for high performance. These homes are known as high performance or super-insulated.

While the structures are produced with energy conservation in mind, one major contributor to the final outcome is the home owner or occupant. This project focuses on the prediction of energy savings utilizing passive strategies that promote specific occupant behaviors (operational strategies) to extend the period when the cooling equipment can remain idle.

During the period of time when the equipment remains idle, 100% energy savings is realized. If the idle period is 20% of the year, 20% of the annual energy is saved.

Using the basic assumption of “degree-days” to illustrate the point, heating of a tradition residence is considered unnecessary when the outside temperature is above 65°F. By the same definition, cooling is assumed to be needed when outside condition is above 65°F. In the summer, the system is said to be operating at 100% of its cooling load during the summer design condition (hot days). Similarly, the heating system operates at its peak load when outside conditions reach its winter design condition. When outside temperature is 65°F, it is assumed that no energy is spent.

Typical energy conservation strategies aim to reduce the peak design conditions. This reduction results in a proportional saving throughout the year. While reduction of design load is absolutely necessary and saves energy, an often overlooked opportunity is to expand the period when neither heating nor cooling is used in a home. This strategy depends on occupant behavior. The question is: can passive design strategies be incorporated in residential structures to promote “better” occupant behavior, that is will the occupant leave the cooling and heating equipment de-energized for longer periods? Not running the equipment results in 100% energy savings during those times.

There are significant hours within the mid-Atlantic region where passive solar or natural ventilation can provide thermal comfort in residential situation without the aid of mechanical heating and cooling equipment. Combining Bin weather data and the energy demand curve can produce a 3-dimentional diagram where the volume of the histograms represent the total energy used (Btu/hr x Hours), which allows for the calculation of the possible energy savings when the de-energized period is expanded using passive strategies.

An important parameter to explore is the resultant thermal comfort offered by the alternative cooling strategies. ASHRAE Standard 55 specifically addresses the more-stringent occupant comfort expectations in mechanically cooled spaces. Occupant expectations are less stringent in naturally cooled spaces. This phenomenon will be integrated into the study. This study will first establish the limitations defined by this standard. As a second step, consider the design criteria when natural ventilation is an integral part of the design.

Manager/PI: Prof. Moses D.F. Ling (Department of Architectural Engineering)

Deliverables: The project will conclude with a research report, a paper for the Residential Building Design and Construction Conference, and likely a journal paper.

3. Shear Wall Opportunities in Residential Construction

Current building codes and standards for residential construction are complex and easily misunderstood when it comes to the requirements pertaining to wood shear walls. Whether they are engineered or prescriptive the design intent has the potential to be lost resulting in improper construction of walls that can lead to poor performance and failure (both aesthetically and structurally). This pilot study will cumulate the vast knowledge regarding residential shear walls options, provide comparisons between behavior and design steps, and finally recommend best practices for constructing. The results will give designers and

builders a better understanding of the complexity of shear wall code provisions and how to go about designing and constructing shear walls through clarifying code intent.

Manager/PI: Dr. Ryan Solnosky and Prof. M. Kevin Parfitt (Department of Architectural Engineering)

Deliverables: The project will conclude with a research report, a paper for the Residential Building Design and Construction Conference, and likely a journal paper.

PART 3 - Applied Projects

The Applied Project category refers to projects that are application-oriented and have a direct need by the residential construction industry. This may also include longer term initiatives.

1. Details that Work: Foundations and Passive Radon Systems

Description: New construction practices create a need for new and innovative details for contractors and sub-contractors to ensure proper installation. These necessary details encompass a wide range of scenarios starting from the footing level through shingles. Details that Work will become an ongoing project to develop details for programs such as speaker services and other training programs. The PHRC will also compile all details into one PHRC detail book. This detail book will be available in PDF form on the PHRC website. During the 2013-2014 project year the details developed were focused on the topics of bulk water, moisture and air management. The topic for the 2014-2015 project year will be Foundations and Passive Radon Systems

Manager/PI: C. Hine

Deliverables: This project will include the development of construction details on the topic of foundations and passive radon systems that will be added to the Details the Work resource on the PHRC website.

2. Crawlspace

Description: Many aspects related to crawlspaces, such as design, location, construction, and code enforcement continue to be areas of concern. The PHRC will review the 2009 IRC crawlspace requirements including structural, energy efficiency, and moisture related provisions, along with applying building science principles to generate design options that will reduce the introduction of moisture, mitigate moisture from the area, and create an area that will increase the health and durability of the area.

Manager/PI: C. Hine

Deliverables: This project will result in both a Builder Brief and a webinar.

3. Insulation Modeling and Durability Assessment

Description: New insulation materials and systems are being introduced to the construction industry quite often, but how these new systems interact with other portions of the building envelope is not often understood. This project will take a fundamental look at common building assemblies and materials found throughout Pennsylvania. Computer modeling software (such as WUFI) will be used to simulate the effects of seasonal temperature changes, wetting/drying cycles, and construction imperfections. These hygrothermal models will allow for analysis of the durability and efficiency of different insulation systems and envelope assemblies (i.e. flash and batt, exterior foam etc.).

Manager/PI: B. Wolfgang

Deliverables: This project will result in a PHRC Research Report and Builder Brief.

4. Stucco: Code Review/Analysis and State of the Art Report

Description: An increase in the number of stucco failures has spurred the need for further investigation. This project will study and address the possibility of stucco failure related to moisture infiltration and rot from installation performed in accordance with the code requirements as outlined in the IRC 2000, 2003, 2006, and 2009 model codes. Each code cycle will be evaluated independently due to variations in the requirements in each code cycle.

Manager/PI: B. Wolfgang

Deliverables: This project will result in a research state of the art report.

5. The Fundamentals of Indoor Air Quality in Residential Buildings

Description: Recently, in an effort to build higher performing homes, more stringent guidelines have resulted in the building envelope on residential homes becoming increasingly tighter. Despite having advantages regarding air leakage and overall energy consumption, maintaining good indoor air quality has become increasingly complicated. This project will streamline the topic of indoor air quality by explaining the key considerations for health and safety issues related to indoor air quality, strategies for controlling pollutants, as well as product selection and installation.

Manager/PI: B. Heitzmann

Deliverables: This project will result in a Builder Brief.

6. Support of the UCC RAC

Description: The International Code Council's (ICC) 2015 codes have been published in June 2014. Soon after the publication of the new codes, Pennsylvania's Uniform Construction Code (UCC) Review and Advisory Council (RAC) will begin their task of reviewing new code provisions and voting for or against their adoption in PA. Following the publication of the 2015 codes, the PHRC will begin to review the documentation and

summarize new code provisions and highlight the ones deemed to be most significant. The PHRC will continue to support the RAC through technical analysis of proposed code changes, as well as serving as a general technical resource upon request.

Manager/PI: K. Blansett, B. Heitzmann

Deliverables: The PHRC will develop and publish a summary of new code provisions, as well as, provide education to the RAC and the public regarding proposed code updates. The PHRC will also continue to serve as a general technical resource to the RAC.

7. Support of Standards

Description: The PHRC has developed three standards to respond to industry demand. 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. The PHRC standards include

- Pennsylvania’s Alternative Residential Energy Provisions - 2009
- Guidelines for Subdivision and Land Development in Pennsylvania (formerly the Pennsylvania Standards for Residential Site Development Standards)
- Foundation Systems for Relocated Manufactured Housing

Manager/PI: K. Blansett, B. Wolfgang

Deliverable: Education will be provided through various training programs as requested and technical assistance will be provided through telephone and email support by the PHRC.

PART 4 - Contingency Projects

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

This section of the plan outlines projects that have been noted as a priority by the IAC that may be undertaken contingent upon the availability of required data and/or funds.

1. 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 US 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. This project was planned for the 2012-2013 project year but data was not available from the Army Cold Regions lab. If the data becomes available the project will be pursued.

Manager/PI: K. Blansett, B. Wolfgang

Deliverable: This project will result in a research report, and a revised snow loads map with more comprehensive coverage of Pennsylvania municipalities (contingent on receiving the necessary data from the US Army Cold Regions lab).

This project is contingent on the availability of funding to the US Army Cold Regions Lab for the processing and release of snow loads data. Cuts in Federal funding are preventing the Lab from processing and releasing the necessary data.

2. Stormwater BMP Effectiveness in Real Residential Developments

Description: This is a multi-year project that involves the selection of an appropriate site, installation of equipment, continued maintenance of equipment, and the collection of both flow and water quality data during multiple precipitation events over several years. The duration of the project is dependent on annual climate conditions and the continued interest and funding in the research.

The project involves the installation of flow monitoring and water sample collection equipment in residential developments to collect long-term data on the characteristics of stormwater runoff from these sites and the effectiveness of Best Management Practices (BMPs) in a typical residential development. Nitrogen (N), phosphorus (P) and sediment (TSS) are the water quality parameters of interest for this study. Flow data along with the constituent concentrations can be used to determine the total load (g) and event mean concentration (EMC, mg/L), or a flow weighted average, which is a parameter commonly used to model water quality. Data will be collected from different types of events (for example, spring rains versus summer thunderstorms versus winter rain on snow) over several years.

The long-term goals of this project are to define the pollutant load from residential developments, and define the effectiveness of different BMPs and treatment trains (BMPs in series).

Manager/PI: K. Blansett

Deliverables: This project will include the collection of flow and water quality data and analysis from multiple events throughout different seasons. Flow and water quality data will continue to be collected and analyzed over multiple seasons. The median event mean

concentration (EMC) for the land use category of residential housing will be calculated and compared to typical reference values. Webinars, publications and presentations can be developed to disseminate the findings.

This project is contingent on the availability of funds. It was planned for the 2013-2014 project year, but as the legislation that would reduce PHRC was proposed in the Pennsylvania Senate in September of 2013, the large equipment purchase needed to move forward with the project was placed on hold. The feasibility of the project will be reassessed when the status of funding is more definite.

Projected Budget by Project Categories

Project	Act 157 Funds	Outside ¹	PSU Support	Total
Training, Technical Assistance and Outreach	\$346,142	\$154,151	\$176,532	\$676,825
Applied Research	\$62,372	\$31,062	\$31,810	\$125,244
Applied Projects	\$72,090	\$58,800	\$36,766	\$167,656
Total	\$480,604	\$244,012	\$245,108	\$969,725

Notes:

1. Outside funding is received from a variety of sources including fees for services, in-kind contributions, industry contributions, grants and contracts.