



The Pennsylvania Housing Research Center

PHRC Year in Review

July 2016 – June 2017

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Table of Contents

I. Introduction.....	1
A. Staff Changes During 2016-2017 Project Year	2
II. Training, Technical Assistance & Outreach.....	3
A. Program Development.....	5
1. HVAC Design and Installation (continuation).....	5
2. IRC Framing Design & Code Compliance.....	5
B. PHRC Training Program Delivery	5
C. Webinar Development and Delivery	8
D. Technical Assistance, Technology Transfer & Outreach.....	9
III. Applied Research	15
1. Laboratory Testing and Analytical Evaluation of Residential Wall R-value for Several Conventional Wall Systems	15
IV. Applied Projects	16
1. Deck Design Spreadsheet	16
2. Exterior Plaster Assemblies in Pennsylvania (continuation)	16
3. Update to the PA Alternative	17
4. Evolution of the Building Enclosure in PA.....	17
V. Proposals & Contracts	19
VI. Act 157 Funds	20

I. Introduction

The purpose of this document is to provide a summary of activities the Pennsylvania Housing Research Center has pursued and products that have been delivered between July 1, 2016 and June 30, 2017.

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

- meet the needs of the residential construction industry and 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 the industry.

The PHRC receives funds from multiple sources including funds collected under Act 157 of 2006, which established a two dollar fee collected for each building permit to support training and education for the construction industry. To assure that programs funded in whole or part with Act 157 monies meet the needs of the construction industry, Act 157 requires that education, training and other activities provided by the PHRC be approved by its Industry Advisory Council (IAC).

The projects undertaken were developed with input and assistance from the PHRC's Industry Advisory Council (IAC). This body consist of builders, developers, design professionals, code officials, manufacturers, suppliers, remodelers, and industry associations as well as state and federal agencies. After a thorough discourse at the spring IAC meeting in April 2016, the members of the IAC voted on projects they felt were the highest priority for the industry.

The result of this input was the "*PHRC Project Plan, July 2016 – June 2017*", which outlined projects that the PHRC would undertake during this time period. The plan included only those projects that were to receive funds provided to the PHRC by the Commonwealth of Pennsylvania through the Act 157 permit fees. When appropriate, the PHRC attempts to use state funding to leverage outside support. It should also be noted that the PHRC undertook an array of additional projects that did not receive any state funds. Some of these projects are included in this report but are identified as having no support from the Act 157 funds.

Through the MOU that Penn State University has with the Department of Community and Economic Development (Contract #27-872-0001), the PHRC is required to submit to DCED an annual work plan and an annual report summarizing the activities for the previous year with

respect to the fee. This “Year in Review, 2016-2017” is submitted to meet the annual report requirement.

A. Staff Changes During 2016-2017 Project Year

The PHRC experienced staff changes during the recent fiscal year, including carryover into the 2017-2018 project year.

1. Dr. Katie Blansett resigned from the Associate Director position effective January 27, 2017. The Associate Director position was posted in January 2017. Brian Wolfgang, former Housing Systems Specialist, was offered and accepted the Associate Director position, effective March 1, 2017.
2. With the Housing Systems Specialist position vacant as of March 1, 2017, the position was posted in May 2017. After a successful search process, Sarah Klinetob Lowe was offered and accepted the Housing Systems Specialist position, effective July 1, 2017.
3. At the start of the 2017-2018 project year, the Budgets & Publications Coordinator position was vacant and expected to be posted in July 2017.

Please refer to Figure 1 for the updated PHRC organizational chart.

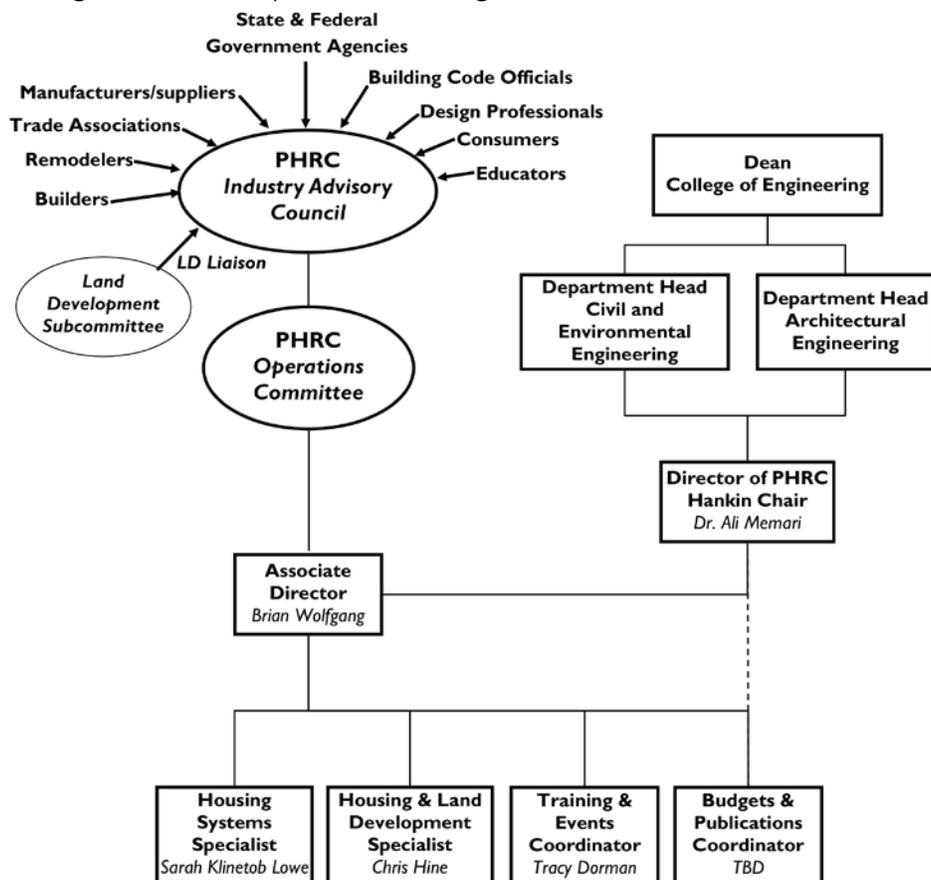


Figure 1. PHRC Organizational Chart

II. 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. To meet this expectations the PHRC offers an array of activities to educate and transfer appropriate technologies to the industry. These activities can include the development and delivery of educational programming using a variety of media, the hosting of conferences/symposia, and the publication of reports, as well as serving as a general resource to the industry in answering questions.

Counting workshops, webinars, speaker services, and conferences, the PHRC provided 46 educational services to 1,607 individuals during this reporting period (Table 1).

Table 1. Summary of all PHRC Educational Programs for the 2016-2017 Project Year

PROGRAM	Activities for 2016-2017	
	# of Events	# of Attendees
Workshops	22	438
Webinars	8	568
Speaker Service	14	438
PHRC Conference/PCCA Symposium (Central)	2	163
TOTAL	46	1,607

The distribution of the number of educational services over the past 17 years is plotted in Figure 2. The total number of programs delivered during the 2016-2017 period is 46, which is less than the average number of programs offered each year since the PHRC started receiving the Act 157 funds (60). This decrease in delivered programs is due to the delayed start in scheduling workshops with the Pennsylvania Construction Codes Academy (PCCA), the PHRC's primary partner in delivering workshops, and their reorganization within the PA Municipal League. These values also reflect the currently lower demand for code-focused training due to the length of time since a major building code change.

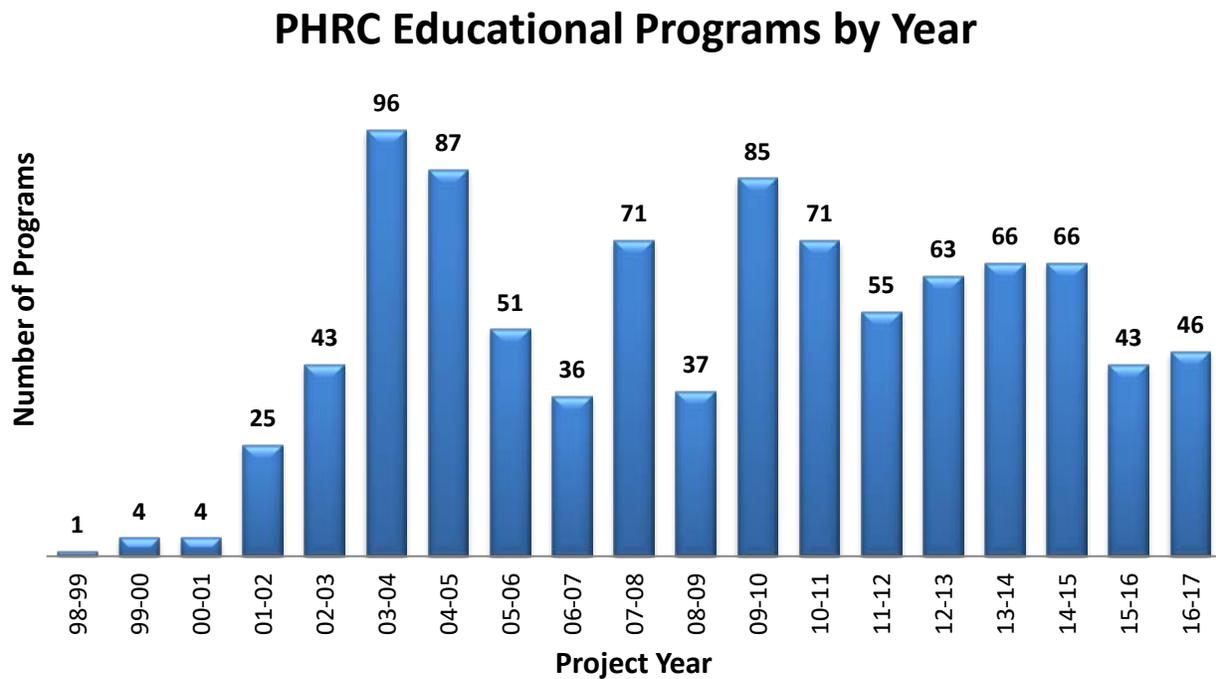


Figure 2. PHRC Educational Programs by Year

The five general categories of the PHRC's work in this area include:

- A. Program Development
- B. PHRC Training Program Delivery
- C. Webinar Development and Delivery
- D. General Technical Assistance, Technology Transfer, & Outreach Activities

The following sections labeled A through D of the report will provide further details on the PHRC's accomplishments in each of these categories.

A. Program Development

The PHRC developed or updated the following training programs. These programs address issues challenging the residential construction industry (builders, developers, remodelers, building code officials, design professionals, materials suppliers, etc.).

1. HVAC Design and Installation (continuation)

Description: As new home construction introduces tighter and more efficient wall assemblies, the need for design and installation of efficient HVAC equipment is essential. With this flexible program, we will work with industry HVAC experts in creating a full day HVAC design and installation class which can also be delivered in two, half-day sessions, or one full-day session. This will be a second of a two-year project. Outside content experts will be consulted for assistance in development and final program review.

Manager/PI: C. Hine

Report: The Residential HVAC Design and Installation workshop has been completed and was offered as a pilot program at the 2017 Housing Conference. During this offering, we had 27 in attendance, and their backgrounds ranged from building code officials to builders. We also plan to offer this workshop in the upcoming year.

2. IRC Framing Design & Code Compliance

Description: The design and implementation of many framing and structural details in residential construction is often taken for granted as experienced framers are relied upon to provide a code compliant light-frame structure. However, as trends continue to call for complicated floor plans and open concepts, components such as connections and the use of new engineered wood products require more attention and detailing. This full day workshop will take a look at the structural requirements of the IRC including connections, fasteners, hangers, wall bracing, as well as some fundamental light-frame design theory.

Manager/PI: C. Hine & B. Wolfgang

Report: The PHRC developed a full-day workshop focused on framing design and code compliance. This workshop includes a discussion of structural theory, material properties, wall framing, wall bracing, floor framing, roof/attic framing, and exterior sheathing. This workshop will be available to schedule during the 2017-2018 project year.

B. PHRC Training Program Delivery

Description: The PHRC has developed and maintains a wide array of training for many 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 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 four categories: (1) Code Refresher, (2) Code Essentials, (3) Academy Programs, and (4) Focused Topics.

(1) Code Refresher programs are 1-day programs that offer a shorter alternative to the multi-day academies and are also well-suited for anyone interested in an introduction to building codes, or information to make inspections go more smoothly.

- | | |
|----------------------------------|-------|
| a. IRC Building Code Refresher | 1 day |
| b. IRC Plumbing Code Refresher | 1 day |
| c. IRC Mechanical Code Refresher | 1 day |
| d. IRC Electrical Code Refresher | 1 day |
| e. IRC Energy Code Refresher | 1 day |

(2) Code Essentials programs are 2-day programs that offer a shorter alternative to the multi-day academies but provide greater depth than the Refresher programs.

- | | |
|--|--------|
| a. International Residential Code Essentials | 2 days |
| b. IRC Plumbing Essentials | 2 days |
| c. IRC Mechanical Essentials | 2 days |
| d. IRC Electrical Essentials | 2 days |
| e. Residential Energy Essentials | 2 days |
| f. Commercial Energy Essentials | 2 days |

(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 Codes Academy | 4 days |
| b. IRC Plumbing Academy | 4 days |
| c. IRC Mechanical Academy | 4 days |
| d. IRC Electrical Academy | 4 days |

(4) **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 certified code officials. As appropriate, AIA Learning Units (LUs) for architects, ICC credits and ICC contact hours for code officials, NARI credits for remodelers, and Professional Development Hours (PDHs) for engineers are offered.

a. Blueprint Reading Program	1 day
b. Building Science Program	1 day
c. International Energy Conservation Code Essentials	1 day
d. HVAC Design and Installation	1 day
e. Two Family Dwellings and Townhouses Program	1 day
f. International Residential Code Inspections	2 days
g. Residential Sprinkler Inspection/Installation	1, 2 days
h. Special Issues with Two-Family Dwellings and Townhouses	1 day
i. Fundamentals of Exterior Plaster and Thin Stone Veneer Assemblies	1 day
j. Residential Energy Plan Review and Inspection	1 day
k. Building Envelope Design and IECC Code Compliance	1 day
l. Building Code Plan Review and Inspection	1 day
m. Residential Deck Design and Construction	1 day
n. Building with Exterior Rigid Foam	1 day
o. Residential Moisture Management: The 4D's	online
p. IRC Framing Design & Code Compliance	1 day

For program descriptions, visit <http://phrc.psu.edu/Industry-Education/PHRC-Training-Programs/Workshops/Available%20Workshops.aspx>.

(5) **Online Training** 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 certified code officials. As appropriate, AIA Learning Units (LUs) for architects, ICC credits and ICC contact hours for code officials, NARI credits for remodelers, and Professional Development Hours (PDHs) for engineers are offered.

During the spring of 2017, the PHRC launched the first live multiple day online workshop. This workshop, titled “Residential Moisture Management: The 4-D’s,” was successful in content and format. It is anticipated that the PHRC will continue to use this online multiple-day format moving forward.

Report: During the 2016-2017 project year, the PHRC delivered 22 workshops to 438 builders, remodelers, educators, code officials, design professionals, and planners during this reporting period (see Table 2 for detail).

Table 2. PHRC Workshops Held July 1, 2016 through June 30, 2017

PROGRAM	In-person/ Online	# of Programs	# of Attendees
Residential Moisture Management: 4 D's	Online	1	8
Building Science Program	In-Person	1	12
IRC Building Code Refresher	In-Person	1	21
Electrical Essentials Academy – 4 days	In-Person	1	13
IRC Residential Code Academy – 4 days	In-Person	1	31
IRC Plumbing Code Academy – 4 days	In-Person	1	19
IRC Mechanical Academy – 4 days	In-Person	1	13
Residential Energy Essentials – 2 days	In-Person	1	17
IRC Electrical Code Refresher – 1 day	In-Person	3	64
Intn'l Energy Conservation Code Essentials	In-Person	1	19
Residential Plan Review and Inspection	In-Person	4	85
HVAC Design and Installation	In-Person	1	27
Two Family-dwellings and Townhouses	In-Person	3	77
Residential Fire Sprinkler – 1 day	In-Person	1	18
Residential Deck Design, Construction & Inspection	In-Person	1	14
<i>Total Programs Held</i>		22	438

C. Webinar Development and Delivery

Description: In today's economic climate, there is a need for educational programs without travel costs. 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.

Manager/PI: K. Blansett and B. Wolfgang

Report: The PHRC delivered eight webinars during this reporting period to a total of 568 people. Due to the PA Housing and Land Development Conference, no webinar was held in March. See Table 3 for the summary of webinars and attendees.

Table 3. 2016-2017 Webinar series titles and number of attendees

Webinar Series		
Month	Title/Topic	Number of Attendees
September	Rainscreen Gaps in External Walls	40
October	Durability of Insulated Rim Joists	57
November	HERS Ratings in PA: Why, What, and How?	65
December	Residential Concrete – 101	108
January	Design and Construction of Downspout Disconnections	114
February	Frost-Protected Shallow Foundations in PA	86
March	No Webinar, PHRC Conference	-
April	Stormwater BMP Maintenance Education for Homeowners	57
May	What does Net-Zero Energy Mean in PA?	41
	<i>Total Attendees</i>	568

D. 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 and B. Wolfgang

Report: The PHRC had organized, developed, and/or delivered the follow activities:

1. The 25th Annual PHRC Conference and PCCA Symposium Central
2. Speaker engagements and conference presentations
3. General outreach activities

1. The 25th Annual PHRC Conference and PCCA Symposium Central

This two-day event provides information and updates on issues of interest to the residential construction industry. The intended audience is builders, remodelers, code officials, design professionals, home performance contractors and other industry related professionals. Day 1 of the conference focuses on issues related to the housing structures and their systems, while Day 2 focuses on Training and Education.

Report: The 25th annual Housing Conference was held on March 1st and 2nd, 2017 at the Penn Stater Conference Center and Hotel in State College, PA. Given that each day caters to distinct audiences of the residential building industry, for the purposes of reporting, each day is recorded as a separate event.

Housing Day (Day 1): Day 1 of the PHRC Conference started off with a keynote from Mark Fortney, Director of Building Science at Gaco Western, entitled “Innovation in Residential Construction – and Adventure in Building Science”. This keynote focused on the construction industry and its adoption of new and innovative products and construction methods at a faster rate.

- Building Science & Technology
 - “Insulation and Air Sealing for Code Performance and Beyond” by JR Babineau
 - “Transforming our Home’s Performance” by Erik Anderson
 - “Residential HVAC Commissioning – What is it and Why do it” by Brian Henderson
- Construction & Management
 - “Framing for the Open Floor Plan and Engineered Lumber” by Matt Hunter
 - “What’s New at OSHA” by Bryan Seal
 - “Stormwater BMP Maintenance Education for Homeowners” by Katie Blansett
- Building Code Track (PCCA Symposium, Central)
 - “PA UCC / Code Enforcement Q & A” by Bob Buddenbohn, Don Forry & Douglas Meshaw
 - “2015 Accessibility Code Changes” by Bob Buddenbohn
 - “Fire Alarm Basics” by Bob Buddenbohn
- Multi-Family & Light Commercial *NEW this year*
 - “Guidelines for Achieving Desired Amount of Sound Isolation Between Units” by Michelle Vigeant
 - “Ag Engineering REDEFINED: IDP at PSU” by Jeffrey Spackman, John Bechtel & Alex Boots
 - “Ventilation in Multi-Family Buildings” by Ahmad Mahmud

The PHRC worked with the PCCA to plan and deliver the 6th Annual PCCA Symposium-Central held in conjunction with the PHRC Housing Conference which had 36 registrants.

PHRC 25th Anniversary Reunion Reception: The PHRC 25th Anniversary Reunion Reception was also held at the Penn Stater Conference Center Hotel. During this reception we invited past PHRC staff members, directors and associate directors along with current and past instructors. This reception was to highlight the last 25 years of the PHRC Housing conference. Additionally, the reception hosted a hard cider tasting from Good Intent Cider, a local Cidery in central Pennsylvania.

Training (Day 2): Two full-day workshops were scheduled in conjunction with the conference, one from the PHRC and the second was offered through PCCA.

- Residential HVAC Design & Installation (PHRC)
 - Pilot offering with Jeff Stoltz and Chris Hine instructing
 - Enrollment: 27
- Two-Family Dwellings & Townhouses (PCCA)
 - Offered at a subsidized registration fee through PCCA
 - Enrollment: 25

Table 4. Attendees at the Housing Day and Land Development Day of the PHRC Annual Conference.

Event	# of people
Housing Day of PHRC Annual Conference (March 1)	127
PCCA Symposia Central - in conjunction with the PHRC Housing Conference (March 1)	36

2. Speaker Engagements

The PHRC participates 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. Over the 2016-2017 reporting period, the PHRC delivered 14 speaker services, reaching 438 people. Speaker service and conference presentations included:

- Blansett, K. "Land Development Process," *Home Builders Association of Metro Harrisburg*, Harrisburg, PA, October 25, 2016, (11 attendees)
- Hine, C. "Construction Drawings," *AE 470 guest Lecture*, University Park, PA, August 31, 2016, (62 attendees)
- Hine, C. "Why Decks Fail – Design and New PA UCC Requirements to Improve Safety," *HBA Bucks / Montgomery*, Fort Washington, PA, September 14, 2016, (8 attendees)
- Hine, C. "Understanding the PA Alternative," *PennBoc Conference*, Grantville, PA, September 30, 2016, (13 attendees)
- Hine, C. "Fire Floor Protection of Light Weight Floors," *Lehigh Valley Builders Association*, Allentown, PA, February 23, 2017, (9 attendees)

- Hine, C. “Indoor Air Quality: Challenges, Considerations & Concerns,” *Builders Association of Metro Pittsburgh*, Pittsburgh, PA, March 10, 2017, (29 attendees)
- Hine, C. “Design and New PA UCC Requirements to Improve Safety,” *Tri-State ASHI*, Plymouth Meeting, PA April 11, 2017, (37 attendees)
- Kamel, E. (presenter) and Memari, A. M., (2017). “Energy Monitoring System for Smart Homes,” *Presented at the 14th Annual College of Engineering Research Symposium (CERS 2017)*, April 4, 2017, University Park, PA (attendance unknown)
- Sagioglu, M. (presenter) and Memari, A. M., (2016). “Review of Developments and New Innovations in Temporary Housing and Foldable Buildings,” *Presented at the 41st IAHS World Congress – Sustainability and Innovation for the Future*, September 13-16, 2016, Alufeira, Algarve, Portugal (attendance unknown)
- Wolfgang, B. and A. Lau, “What Does Net-Zero Energy Mean in PA,” *Pennsylvania Manufactured Housing Association Annual Meeting*, Grantville, PA, March 15, 2017. (65 attendees)
- Wolfgang, B. “Energy Code Compliance in Exterior Wall Assemblies,” *Commonwealth Building Officials Annual Code Conference*, Seven Springs, PA, November 2, 2016. (15 attendees)
- Wolfgang, B. “Fundamentals of Exterior Plaster and Thin Stone Veneer,” *Home Builders Association of Berks County*, Wyomissing, PA, October 6, 2016. (30 attendees)
- Wolfgang, B. “HERS Ratings in PA: Why, What, and How?” *Builders Association of Metro Pittsburgh*, Pittsburgh, PA, March 10, 2017. (29 attendees)
- Wolfgang, B. “The Role of Building Codes in Residential Construction,” *Middle Bucks Institute of Technology*, Jamison, PA, February 10, 2017. (130 attendees)

5. General Outreach Activities

The general outreach activities of the PHRC include activities to let builders know about the PHRC and the services and publications it provides. These activities may include PHRC mailings, promotional pamphlets, articles in research or trade journals, answering phone and email questions, and the maintaining PHRC’s website, as well as various relevant technical meetings attended by PHRC staff.

Publications

The following list includes the scholarly publications published during the reporting period.

- Lu, X. and Memari, A. M., (2017). “Performance Evaluation of Wall Panels Incorporating New and Innovative Materials Developed with High Insulation

Properties,” Final Report, The Pennsylvania Housing Research Center, Submitted January 2017, 35 p.

- Ramaji, I. J., Memari, A. M., and Messner, J. I., (2017). “A Product-Oriented Information Delivery Framework for Multi-Story Modular Building Projects,” *ASCE Journal of Computing in Civil Engineering*, Published online 1/23/17, pp. 04017001-1-17.
- Sagioglu, M. and Memari, A. M., (2016). “Review of Developments and New Innovations in Temporary Housing and Foldable Buildings,” *Proceedings of the 41st IAHS World Congress – Sustainability and Innovation for the Future*, September 13-16, 2016, Alufeira, Algarve, Portugal, 10 P.
- Zahmatkesh, F. and Memari, A. M., (2017). “Review of Conventional and Innovative Technologies for Fire Retrofitting of Existing Buildings,” *Scientific Research Open Journal of Civil Engineering*, Vol. 7, No. 2, pp. 222-244.

Conferences/Meetings Attended

The following is a list of the housing industry-related conferences and meetings attended by the PHRC personnel.

- Blansett, K., T. Dorman, C. Hine, S. Klinetob Lowe, A.M. Memari, and B. Wolfgang. Building Commissioning Association Symposium, University Park, PA, October 20, 2017.
- Blansett, K. Pennsylvania Uniform Construction Code Review and Advisory Council Meeting, Harrisburg, PA, September 14, 2016.
- Hine, C., A.M, Memari, and T. Dorman. International Builders Show and NAHB Student Chapter Residential Construction Management Competition, Orlando, FL, January 10-12, 2017.
- Hine, C. and B. Wolfgang. Pennsylvania Uniform Construction Code Review and Advisory Council Meeting, Harrisburg, PA, March 16, 2017.
- Memari, A.M., (2017). Attended Industry Xchange, COE, PSU, May 24, 2017.
- Wolfgang, B., EEBA Excellence in Building Conference, Frisco, TX, September 27-29, 2016.
- Wolfgang, B., NAHB Student Chapter Advisory Board Meeting, Miami, FL (call-in), August 10, 2016.
- Wolfgang, B., NAHB Student Chapter Advisory Board Meeting, Washington, D.C., June 16, 2017.
- Wolfgang, B. Penn Residential Energy Codes Workshop, Wilkes-Barre, PA, October 11, 2017.
- Wolfgang, B. U.S. Department of Energy Race to Zero Competition, Golden, CO, April 22-23, 2017.

Service in Professional Societies

The PHRC staff and faculty are involved in a variety of organizations at both the state and national level.

Pennsylvania Committees and Organizations

- Wolfgang, B. Builders Association of Central PA, Education Committee Chairman
- Wolfgang, B. Central PA Institute of Technology Carpentry Program Occupational Advisory Committee Member
- Wolfgang, B. State College Area School District Building Construction Technology Program Occupational Advisory Committee Member

National and International Committees and Organizations

- Memari, A.M., American Society of Civil Engineers, member.
- Memari, A. M., Architectural Engineering Conference 2017, Oklahoma City, Oklahoma, April 12-14, 2017; Role: Steering Committee Member
- Memari, A. M., National Consortium of Housing Research Centers, Executive Committee and Annual meeting, National Housing Endowment meetings; Orlando FL January 8-11, 2017
- Wolfgang, B., ASTM International, member and C11 Committee Gypsum and Related Building Materials and Systems member.
- Wolfgang, B., National Association of Home Builders Student Chapter Advisory Board member.

Annual Newsletter

The PHRC develops and delivers an annual newsletter to keep interested parties up-to-date on recent PHRC activities and to promote the PA Housing and Land Development conferences. In 2015 the newsletter delivery schedule shifted from January to earlier in the fall to be more aligned with the project reporting and planning. The 2017 newsletter is expected to be mailed in early fall and will include project reports from the 2016-2017 project year and highlights of projects to come in the 2017-2018 year.

Educating the Next Generation of Tradespeople

Educating the “next generation” of residential trade contractors is essential for the future of residential construction. With the support of the IAC, the PHRC is considering 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 includes 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.

A scholarship program was offered for the 25th Annual PHRC Conference. Eleven students from across the state were able to attend the conference at no fee due to the scholarship. PHRC staff are also involved with outreach through speaking to and interacting with various groups including students in other classes at Penn State, the State College Building Construction Technology Program, the Central PA Institute of Technology Carpentry Program, and the Middle Bucks Institute of Technology.

III. 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. Projects in this category foster partnerships and draw on the expertise and strengths of the people and facilities available at the Pennsylvania State University.

1. Laboratory Testing and Analytical Evaluation of Residential Wall R-value for Several Conventional Wall Systems

Description: As more innovative and alternative wall systems to conventional wood-frame systems are becoming available to builders offering additional choices, more accurate thermal evaluation of these systems becomes essential. Designers and manufactures of newer wall configurations would certainly like to market such products for higher R-values of a finished wall system, which may include insulation, sheathing, vapor retarder, air barrier, and interior and exterior finish layers.

The two available analytical approaches for determining R-values, Parallel Path Method and Isothermal Method, yield significantly different results. Although each method has its strength for certain type of configuration (e.g., stud wall vs. CMU wall), many new wall systems may have features that makes it difficult to say which method is more appropriate. Numerical methods for whole-wall R-value or clear-wall R-value based on computer simulation can provide a calculation of a wall R-value, but values determined through real-model testing is needing to calibrate and validate the simulation. The objective of this proposed project is to test a selected subset of most commonly used wall systems at the Building Enclosure Testing Laboratory (BeTL) using the climate chamber as a hot-box for determination of clear wall R-values to compare the selected wall types. The result of the study will also provide a basis for comparison of other walls that may be tested at the lab at a future time, hopefully by support from the industry. Both analytical and numerical approaches will also be used to compare with test results. The project will develop a thorough review of past studies.

Manager/PI: Dr. Ali Memari

Report: The project has made good progress in developing a thorough review of analytical, numerical and experimental testing methods to determine thermal properties of walls. The analytical methods include Parallel Path method and Isothermal Plane methods, while the numerical method based on the finite element modeling as part of the software THERM has been used. The experimental method reviewed include a guarded hot-box testing method that will rely on an environmental chamber such as the one at BeTL lab. Another approach reviewed is thermographic approach using infrared camera. Comparison has been made between the analytical approaches and the numerical method. Work is ongoing to carry out some laboratory testing to evaluate thermal resistance of selected wall types.

IV. 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. Deck Design Spreadsheet

Description: The portions of the 2015 IRC related to decks that have been incorporated into the PA UCC provide design guidance and a prescriptive path for deck design. The final goal of this project is to create a working spreadsheet that will allow the user to plug in overall deck dimensions for standard decks and have results that show the required design criteria.

Manager/PI: C. Hine

Report: At this time, the spreadsheet is completed and is ready for industry peer review. After the peer review, all comments will be considered and the final document will be generated. The document will be available for download on the PHRC website.

2. Exterior Plaster Assemblies in Pennsylvania (continuation)

Description: Exterior plaster continues to be a hot topic in Pennsylvania as efforts to improve best practice are ongoing. This project would include activities such as providing technical support, construction detail development, and assistance in the development of general outreach to builders, design professionals, code officials, and home inspectors.

Manager/PI: B. Wolfgang

Report: The PHRC continued to support the building industry and the Pennsylvania Builders Association and their technical needs related to exterior plaster assemblies through speaking engagements and other support. The PHRC also launched a new online workshop

series focused on moisture management, which is closely tied to the issues of stucco failure and remediation.

3. Update to the PA Alternative

Description: Over the years, the PHRC has developed several standards to respond to industry demand. Each of these standards includes a consensus process to determine content and requires training and timely technical assistance for local governments, builders/developers, design professionals, and contractors. All of these standards are available electronically for free on our website.

The most recent version of the PA Alternative Residential Energy Provisions is the 2009 edition. Since new code provisions from the 2015 IRC/IECC were adopted in PA and became enforceable in January 2016, it is time to revisit the Alternative Provisions. It is important that this document remain relevant throughout the PA residential construction industry. Updating this document would involve the identification of stakeholders and the formation of an advisory committee, similar to previous update processes. Through the guidance of this committee, new code provisions that have been adopted in PA would be analyzed and considered for inclusion in an updated version of the PA Alternative. Additionally, other provisions that would provide alternative means of compliance (yet equivalent code stringency) could be considered.

The time period for this project is currently open ended and must respond to both the consensus process for content development, and pending legislation that may change what provisions of the energy codes are applicable in PA.

Manager/PI: B. Wolfgang

Report: The PHRC staff developed a road map for updating the Pennsylvania Alternative Residential Energy Provisions, including an outline of the stakeholders involved in the update process. However, after extensive discussion with the PA Department of Labor & Industry on January 23, 2017, it was determined that PA Labor & Industry views the PA Alternative Residential Energy Provisions as a document that is equivalent to the current PA base code (2009 I-codes) and does not believe it is necessary to update the PA Alternative until the base code changes. Therefore, this project has been tabled until there are changes to the PA base code.

4. Evolution of the Building Enclosure in PA

Description: The forces that determine the design and specification of building enclosures in residential construction include energy code requirements, consumer expectations, and broad environmental goals. Each of these forces has led to a distinct evolution of how the building enclosure is designed and constructed. This project would take a closer look at the timeline for these changes, the current state of practice in the Pennsylvania construction

industry, and where the industry may go in the future. This project would take a “lessons learned” approach with an emphasis on building airtightness.

Manager/PI: B. Wolfgang

Report: This project evolved into a potential (future) speaking engagement topic, presentation, and handout. The execution of this project included significant contributions from student assistance, specifically Emma Dickson. The hour-long PowerPoint presentation focuses on various components of the building enclosure and the way that these components have evolved since World War II. The handouts are meant to accompany this presentation and summarize the changes discussed in the presentation.

V. Proposals & Contracts

The PHRC continuously seeks to leverage funding from the Commonwealth with funds from other sources. The following is a list of major grant proposals submitted to the government during the 2016-2017 project year. Several other smaller proposals were also submitted and some are under review/negotiation but those not are reported here.

The following research proposals were submitted during this reporting period:

- Autodesk, Title: “3D Printing of Concrete”, Date: January 2017 – December 2018, Funded \$100,000, Co-PI.
- National Institute of Standards and Testing (NIST), Title: “Hurricane Resiliency through Retrofit of Residential Buildings to Resist Hurricane Wind and Storm Surge”, Date: June 1, 2017 – May 31, 2020, Funds Requested: \$554,659, PI.

VI. Act 157 Funds

The PHRC receives funding from diverse sources, including contracts, grants, membership fees, fees for services, and the funds collected under Act 157 of 2006. Additional contributions were made by the Pennsylvania State University through a variety of sources, including the Hankin Endowment and in-kind support.

Act 157 of 2006 funds are collected through a \$4 fee on every building permit issued in the Commonwealth, and are dispersed through the Department of Community and Economic Development. PHRC receives 50% of the collected permit fees minus a 7.5% administrative fee. Funds for the 2016-2017 Project Year are based upon funds received from July 2015-June 2016. Table 5 below shows the amount received during the July 2015-June 2016 time period.

Table 5. Summary of Act 157 Funds received during the 2015-2016 fiscal year used for the 2016-2017 PHRC Project Year.

Collection Period	Amount Received
Q3: July 2015 - September 2015	\$96,921.50
Q4 October 2015 - December 2015	\$116,514.85
Q1: January 2016 - March 2016	\$84,574.60
Q2: April 2016 - June 2016	\$157,105.70
Total	\$455,116.65

During this reporting period, total expenses were \$676,093.28 (Figure 3). Funds from Act 157 were utilized for 61% of these expenses. Other, non-Act 157 funds sources covered the remaining 39% of costs, including 14% covered by income from fees and services, and 2% covered by other funds. Additionally, external project grants were utilized for 7% of the annual project costs. Funds, grants and contracts managed by the Hankin Chair covered 16% of costs. Table 6 shows the breakdown of expenses by category for the Act 157 account and combined non-Act 157 funding sources.

Expenses for the Act 157 account (\$411,665.15) were lower than the revenues (\$455,116.65) for the 2016-2017 fiscal year. This difference is primarily due to the salary cost savings during the Associate Director vacancy (February 2017) and Housing Systems Specialist vacancy (March 2017 – June 2017), as well as earmarked funds for the 2016-2017 Applied Research project that will continue to be utilized through the 2017-2018 fiscal year. All of these carryover funds will be utilized in future fiscal years.

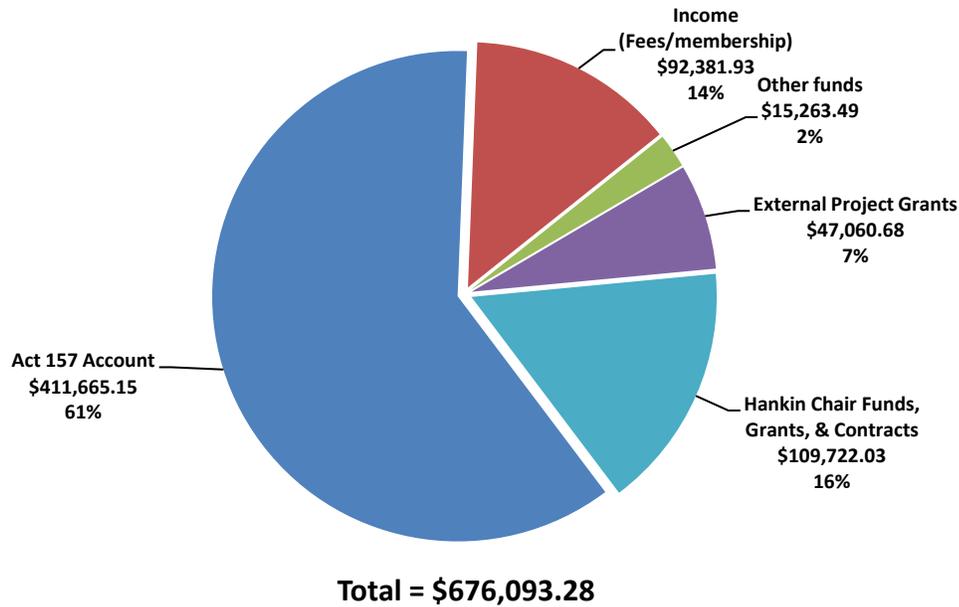


Figure 3. Summary of Funding for the 2016-2017 PHRC Project Year

Table 6. PHRC Expenses for the 2016-2017 PHRC Project Year.

Category	Act 157	Combined Non-Act 157 Funds	Total
Total Salaries	\$234,540.72	\$120,677.08	\$355,217.80
Total Wages	\$960.00	\$11,201.90	\$12,161.90
Total Student Wages	\$6,856.00	\$0.00	\$6,856.00
Fringe Benefits	\$94,367.12	\$49,385.94	\$143,753.06
Supplies and Materials	\$167.53	\$3,469.50	\$3,637.03
Communications Services	\$2,330.32	\$315.48	\$2,645.80
Travel	\$20,160.84	\$45,624.39	\$65,785.23
Publications	\$600.00	\$813.15	\$1,413.15
Consulting & Prof Svc	\$42,150.00	\$120.65	\$42,270.65
Copies and Photographic Services	\$7,356.13	\$2,812.02	\$10,168.15
Scholarships	\$0.00	\$5,600.00	\$5,600.00
Tuition and Fees	\$0.00	\$0.00	\$0.00
Equipment	\$26.49	\$3,376.13	\$3,402.62
Purchased Services	\$550.00	\$1,803.93	\$2,353.93
Miscellaneous	\$1,600.00	\$5,030.86	\$6,630.86
Indirect Costs (Overhead)	\$0.00	\$14,197.10	\$14,197.10
Total	\$411,665.15	\$264,428.13	\$676,093.28