Affordable Solid Panel "Perfect Wall" System

2017 Building Technologies Office Peer Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Project Summary

Timeline:
Start Date: July 1, 2016 (New Project)
Planned End Date: June 30 2019

Key 2017 Milestones

- Milestone 3: Complete optimized plans and specs for 2 house designs; March '17
- Milestone 4: Select and train one builder to execute MonoPath system: March '17

Key Partners:

MonoPath	Unico
Twin Cities Habitat for Humanity	Huber Engineered Woods
Urban Homeworks	
Thrive	
Building Knowledge	

Budget:

Total Project $ to Date:

- DOE: $57,258
- Cost Share: $21,388

Total Project $:

- DOE: $897,860
- Cost Share: $232,578

Project Outcomes:

- Targeting Building America goals to demonstrate reduction of EUI by 60% in new homes by 2020.
- Validate design and construction of an affordable "Perfect Wall" moisture-managed building envelope system that will achieve ZERH specs.
- The whole house system is easily adaptable by affordable housing programs on a national basis through ease of construction and lower cost.

Purpose and Objectives

Problem Statement:

Adopting a fully-optimized, high-performance building envelope approach, such as the “perfect wall”, requires overcoming significant builder resistance, installation challenges, and cost implications.

- This project addresses these challenges by working with multiple partners to build, compare, and measure the new system on numerous houses.
- The validation of this innovative wall system and delivery approach will demonstrate its fit with Residential Building Integration goals.

Target Market and Audience:

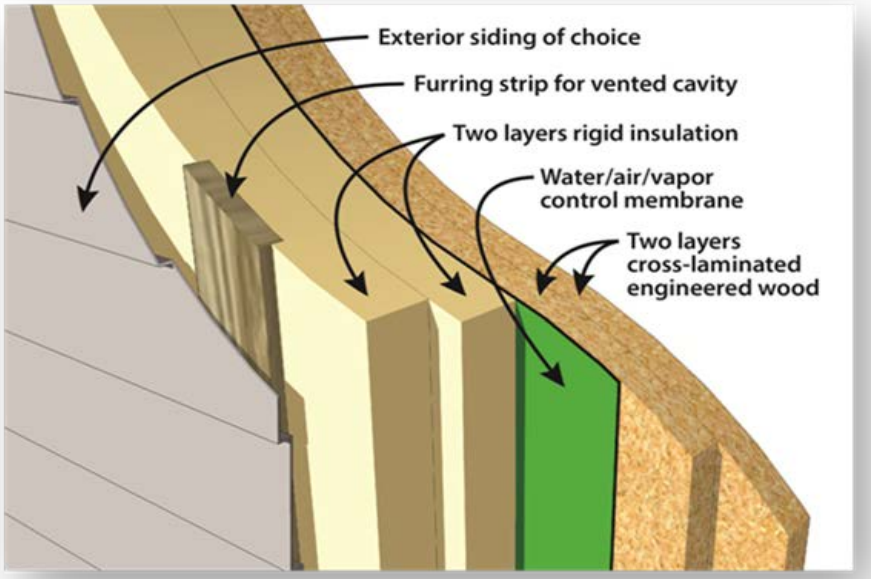
The affordable housing market (single and multiple family) is generally 10% of the total new homes built. The recent housing crisis left hundreds of cities with thousands of vacant lots.

- This project will present these entities with high-performance houses built stronger, faster, better, at a lower cost.
- These homes are sold at market rate with subsidy to make them affordable. This factor takes the homes out of the speculative market and into a “programmed sale” market.

Purpose and Objectives

Impact of Project:

A better way to build high-performance at a lower cost. Following the RBI Logic Model of market adoption acceleration, this building process delivers improved quality control with less-skilled labor to facilitate market acceptance.



- Build 23 houses in two locations to test, measure, and validate performance, cost, constructability,, and market acceptance.
- Train 2 to 4 builders to construct homes that will demonstrate a business model and market viability that can help reach the BTO MYPP RBI goals for whole house solutions and Zero Energy Ready Homes at scale.
- Since the MonoPath building system works in all climate zones, this approach can be readily moved into other national affordable housing markets (e.g. Habitat for Humanity, Neighbor Works), which follows and supports the RBI Program Logic Model.
- The City of Minneapolis is currently developing a model to build more efficiently on a large number of City owned lots. This method could work in any city, producing thousands of affordable homes, and be deployed after the grant to many cities (e.g., Chicago, St. Louis, Oklahoma City, Detroit).

Approach

Approach: Build 23 real-world houses through the existing affordable housing industry processes.

- Test, evaluate, and train to produce and replicate two designs and multiple houses.
- Validate the innovative building structure and delivery process through demonstration, verification, and comparative analysis.

Key Issues: Builders aren't adopting an optimized "perfect envelope" approach due to perceived complexity and cost. They resist giving up "stick" building which keeps them from achieving more effective thermal and moisture management.

Distinctive Characteristics: Three critical aspects for "perfect homes":

- Control layers must go outside of structure.
- Studs framing is problematic; structural engineered panels are easier and lower cost.
- Single envelope contractor ensures QA/QC and reduced cost.

Progress and Accomplishments

Accomplishments: We are a new project and are currently ahead of our milestone timeline. We already have 2 builders committed and 2 house designs completed.

Market Impact: Building for this project will start in Spring ’17. However, there were 11 prototypical houses built prior to this project. Using that knowledge base, there is confidence that proceeding was warranted. All of the houses sold quickly in the urban neighborhoods. Builders, contractors, inspectors understand the system. Our partners will build most houses this season with a few in Spring ‘18.

- Market impact efforts include educating local and national “affordable housing” groups about the house along with its building and delivery system.
- We will measure performance, constructability, cost, and market delivery.
- We will develop protocols for training, detailed cost analysis, and energy as soon as we have complete the comparative (stud vs. panels) analysis.

Lessons Learned: It is difficult to change the building industry perception of the house as a composite of many layers, parts, and contractors. The new system must be presented for instruction and deployment with this in mind.

Project Integration and Collaboration

Project Integration: Field work by the P.I., project manager, 5 staff, and 3 project coordinators. The staff (project management team) meets twice per month, and we meet monthly with our building/developers. The staff develops the timeline and division of work, and then works individually with our builder/developer partners.

Partners, Subcontractors, and Collaborators:

Field Partners:

- ***2 non-profit builder/dev***
  - Habitat for Humanity
  - Urban Homeworks
- ***2 for-profit builders***
  - Morrissey Builders
  - New Look
- ***1 for-profit developer***
  - Thrive (Denver)

Industry Partners:

MonoPath, LLC provides design, engineering, training, and building process expertise for MonoPath houses.

Building Knowledge, Inc. is a rater and trainer for ZERH.

Huber Engineered Woods manufactures panels and provides expert advice for their products.

Unico: Advises with HVAC issues.

Communications: Presented our project formally to a national training for affordable housing builders affiliated with Neighbor Works. We have presented to various housing groups with the City of Minneapolis, including council members and planning department.

Next Steps and Future Plans

Next Steps:

- Fully execute our current project plan.
- Provide support for builder training and system integration.
- Implement our test plan for performance, constructability, costs.
- Conduct an analysis on market delivery and acceptance.

Future Plans:

- Expand this technology and delivery system model to a wider base of affordable housing developers and/or single enclosure contractors in our current markets.
- Continue our conversations with national affordable housing networks that can provide entry to other locales that have a critical need for high-performance, affordable housing.
- Explore opportunities to develop an HVAC+DHW approach and delivery systems that can complement this enclosure system.

Project Budget

Project Budget: This new project started on July 1, 2016 and has a Total Cost of $1,130,439 ($897,860 DOE Share) over 3 years. The funding level is larger for front-end design and construction oversight and is smaller for the monitoring and analysis in the final year. We have successfully completed project set up, Test Plan, and Project Management Plan. We have started partner engagement and design.
Variances: Funding levels in Q1 and Q2 were slightly less than budgeted.
Cost to Date: $78,646 ($57,258 DOE Share); 15% of BP1 and 7% of Total Project.
Additional Funding: Nothing beyond cost share at this time.

Budget History					
FY 2016 (past)		FY 2017 (current)		FY 2018 – FY 2019 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$ 0	$ 0	$399,777	$104,704	$498,084	$127,782

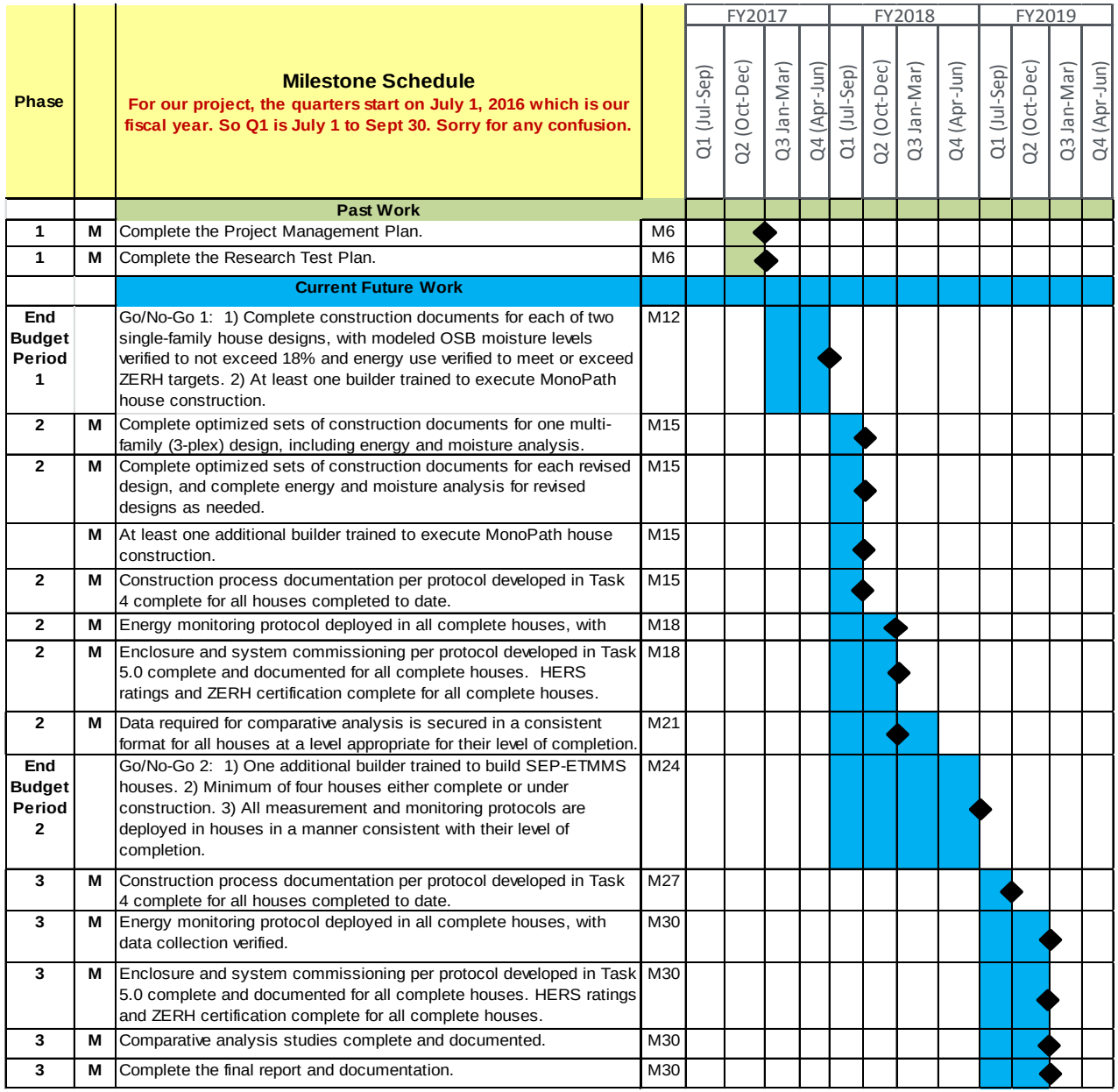
Project Plan and Schedule

Project Timeline:

Start Date: July 1, 2016

End Date: June 30, 2019

Phase		Milestone Schedule For our project, the quarters start on July 1, 2016 which is our fiscal year. So Q1 is July 1 to Sept 30. Sorry for any confusion.	
		Past Work	
1	M	Complete the Project Management Plan.	M6
1	M	Complete the Research Test Plan.	M6
		Current Future Work	
End Budget Period 1		Go/No-Go 1: 1) Complete construction documents for each of two single-family house designs, with modeled OSB moisture levels verified to not exceed 18% and energy use verified to meet or exceed ZERH targets. 2) At least one builder trained to execute MonoPath house construction.	M12
2	M	Complete optimized sets of construction documents for one multi-family (3-plex) design, including energy and moisture analysis.	M15
2	M	Complete optimized sets of construction documents for each revised design, and complete energy and moisture analysis for revised designs as needed.	M15
	M	At least one additional builder trained to execute MonoPath house construction.	M15
2	M	Construction process documentation per protocol developed in Task 4 complete for all houses completed to date.	M15
2	M	Energy monitoring protocol deployed in all complete houses, with	M18
2	M	Enclosure and system commissioning per protocol developed in Task 5.0 complete and documented for all complete houses. HERS ratings and ZERH certification complete for all complete houses.	M18
2	M	Data required for comparative analysis is secured in a consistent format for all houses at a level appropriate for their level of completion.	M21
End Budget Period 2		Go/No-Go 2: 1) One additional builder trained to build SEP-ETMMS houses. 2) Minimum of four houses either complete or under construction. 3) All measurement and monitoring protocols are deployed in houses in a manner consistent with their level of completion.	M24
3	M	Construction process documentation per protocol developed in Task 4 complete for all houses completed to date.	M27
3	M	Energy monitoring protocol deployed in all complete houses, with data collection verified.	M30
3	M	Enclosure and system commissioning per protocol developed in Task 5.0 complete and documented for all complete houses. HERS ratings and ZERH certification complete for all complete houses.	M30
3	M	Comparative analysis studies complete and documented.	M30
3	M	Complete the final report and documentation.	M30



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