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Plans for Energy Efficient Homes in Greensburg, KS

Building America Report - 0804
19-Dec-2008
Joseph Lstiburek and Alex Lukachko

Abstract:

Following the almost complete destruction of Greensburg, Kansas by a tornado in May, 2007, Building Science Corporation (BSC) was contracted to provide example house plans, support for the reconstruction of energy efficient houses and training for builders and trades. This report describes the results of BSC's work to construct more than 20 energy efficient, affordable, durable houses in Greensburg, Kansas.

SYSTEMS ENGINEERING APPROACH TO DEVELOPMENT OF ADVANCED RESIDENTIAL BUILDINGS

15.E.2 PLANS FOR ENERGY EFFICIENT HOMES IN GREENSBURG, KS

RE: TASK ORDER NO. **KAAX-3-32443-15**
UNDER
TASK ORDERING AGREEMENT NO. **KAAX-3-32443-00**

MIDWEST RESEARCH INSTITUTE,
NATIONAL RENEWABLE ENERGY LABORATORY DIVISION,
1617 COLE BOULEVARD,
GOLDEN, CO
80401-3393

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THE DOW CHEMICAL COMPANY
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FORTIFIBER
GEORGIA PACIFIC
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HUBER ENGINEERED WOOD PRODUCTS
ICYNENE, INC.
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U. S. GREENFIBER, LLC
TAMLYN
RESEARCH PRODUCTS CORPORATION/APRILAIRE

DECEMBER 19, 2008

15.E.2 - Plans for Energy Efficient Homes in Greensburg, KS

Joseph Lstiburek, Building Science Corporation
Alex Lukachko, Building Science Corporation

December 19, 2008

Abstract

Following the almost complete destruction of Greensburg, Kansas by a tornado in May, 2007, Building Science Corporation (BSC) was contracted to provide example house plans, support for the reconstruction of energy efficient houses and training for builders and trades. This report describes the results of BSC's work to construct more than 20 energy efficient, affordable, durable houses in Greensburg, Kansas.

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15.E.2 - Plans for Energy Efficient Homes in Greensburg, KS

Executive Summary

1. Overview

Following the initial emergency response to the destruction of Greensburg, Kansas by a direct hit by a massive tornado, the Department of Energy joined other federal agencies, including FEMA and the EPA, in providing long-term recovery support for Greensburg residents. The DOE's effort included support for power generation and distribution planning, advice for energy efficient building construction, and assistance for builders and homeowners.

Building Science Corporation (BSC), a research team working with DOE's Building America program, was contracted to provide example house plans, support for the reconstruction of energy efficient houses and training for builders and trades. This report describes the results of BSC's work to construct more than 20 energy efficient, affordable, durable houses in Greensburg, Kansas.

2. Key Results

Twenty houses have been constructed meeting greater than 40 percent whole-house energy savings compared to the BA Benchmark. The approach demonstrated performance benefits and cost savings such that the development group (Mennonite Housing) has adopted the technology for all of their projects in Kansas.

3. Next Steps

Testing and monitoring of the constructed homes will be completed by NREL.

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15.E.2 - Plans for Energy Efficient Homes in Greensburg, KS

1. INTRODUCTION

1.1 Task Description

This task provides technical support for energy efficient reconstruction of the residential areas affected in the aftermath of the recent natural disaster in Greensburg, Kansas. In coordination with NREL, the Subcontractor shall develop plans and other documents in support of the construction of new energy-efficient homes in this region. The subcontractor shall develop one example set of floor plans, and provide technical support for communications materials being prepared by NREL for upcoming events in Greensburg. In addition, five sets of standardized construction documents (adapted to various foundation types and lot characteristics) shall be developed for the community, and additional direct technical assistance shall be provided to ten residents or builders that act as early adopters of the standard floor plans. The subcontractor shall also develop and distribute overview booklets describing the energy efficiency features of the proposed plans, design and construct a sample wall section to illustrate the recommended building techniques, and conduct eight half-day training sessions in Greensburg to teach local builders and contractors about advanced energy efficient construction techniques, foundation details, and mechanical and electrical system details.

Deliverable:

Working with lead builders and homebuyers in Greensburg, the Subcontractor shall report on ten projects, derived from five standard floor plans, that are expected to achieve at least 30% whole-house energy savings compared to the BA Benchmark. The report shall include:

- *projected whole-house source energy savings compared to the BA Benchmark and regional standard practice.*
- *initial estimates for increases in retail costs required to achieve targeted energy savings levels as a function of individual system performance upgrades and improvements.*
- *plans for quality control tests and energy performance measurements.*
- *a description of expected technical barriers that may limit adoption of advanced systems to be tested by the project.*
- *recommendations for optimum construction and delivery processes and infrastructure requirements to successfully build advanced buildings.*

1.2 Background

On May 4, 2007, the city of Greensburg, Kansas was almost completely destroyed by a large tornado.[1]

Following the initial emergency response, the Department of Energy joined other federal agencies, including FEMA and the EPA, in providing long-term recovery support for Greensburg residents. The DOE's effort included support for power generation and distribution planning, advice for energy efficient building construction, and assistance for builders and homeowners.

[1] For more information on the Greensburg tornado event, see http://en.wikipedia.org/wiki/Greensburg,_Kansas

Figure 1.1: Aerial Photograph of Tornado Damage at Greensburg, KS (source: Jaime Oppenheimer/The Wichita Eagle)

Building Science Corporation (BSC), a research team working with DOE's Building America program, was contracted to provide example house plans, support for the reconstruction of energy efficient houses and training for builders and trades.

This report describes the results of BSC's work to construct more than 20 energy efficient, affordable, durable houses in Greensburg, Kansas.

2. TECHNOLOGY PACKAGE FOR GREENSBURG, KS

2.1 Technology Package Summary

The technology package recommended for Greensburg, Kansas was based on previous work by Building Science Corporation in the Mixed-Humid climate. Our recommendation was also tailored to provide a package that could be justified within the expected construction budget for rebuilding a house in Greensburg. The additional capital cost was shown to be fully offset by the energy savings predicted by our energy analysis (see Section 2.2 below). To further reduce the upfront cost, BSC arranged an incentive program for the first 10 houses built to this specification (see Section 3 below).

Table 2.1 and Figure 2.1 below show the characteristics for both the base case house for comparison and the BSC recommendation.

Table 2.1: Specification Summary Table

	BA Benchmark Design	Proposed BSC Design
Building Enclosure		
Roof	Composition Shingles	Composition Shingles
Ceiling	R-33 spray foam at flat ceiling plane	R-50 flat attic
Walls	R-14 2x6 16" o.c. (frame wall)	R-19 2x6 24" o.c. OVE + R-7.5 XPS
Foundation	R-8.7 basement wall	R-14 basement wall
Windows	Aluminum clad wood with clear laminated glass (U=0.94, SHGC=0.74)	Vinyl clad double glazed spectrally selective, gas filled (U=0.30, SHGC=0.26)
Infiltration	0.33 nACH	1.5 sq in leakage area per 100 sf envelope
Mechanical systems		
Heat	78% AFUE furnace in vented attic	8.5 HSPF Air Source Heat Pump in conditioned attic
Cooling	10 SEER split system	15 SEER split system in conditioned attic
DHW	Standard Tank Hot Water EF=0.54	Sealed combustion tank water heater (EF=0.62)
Ducts	R-8 flex runouts in vented attic	R-8 flex runouts in conditioned basement
Leakage	Average duct tightness (15%)	none to outside (5% or less)
Ventilation	62.2 CFM rate (55.7 CFM)	Central Fan Integrated Supply Ventilation
Lighting	86% Incandescent	100% Energy Star CFL
Appliances	standard appliances	Energy Star fridge, DW, clothes washer

Note: Electricity rate is 11 cents/kWh
Natural Gas is $1.23/therm

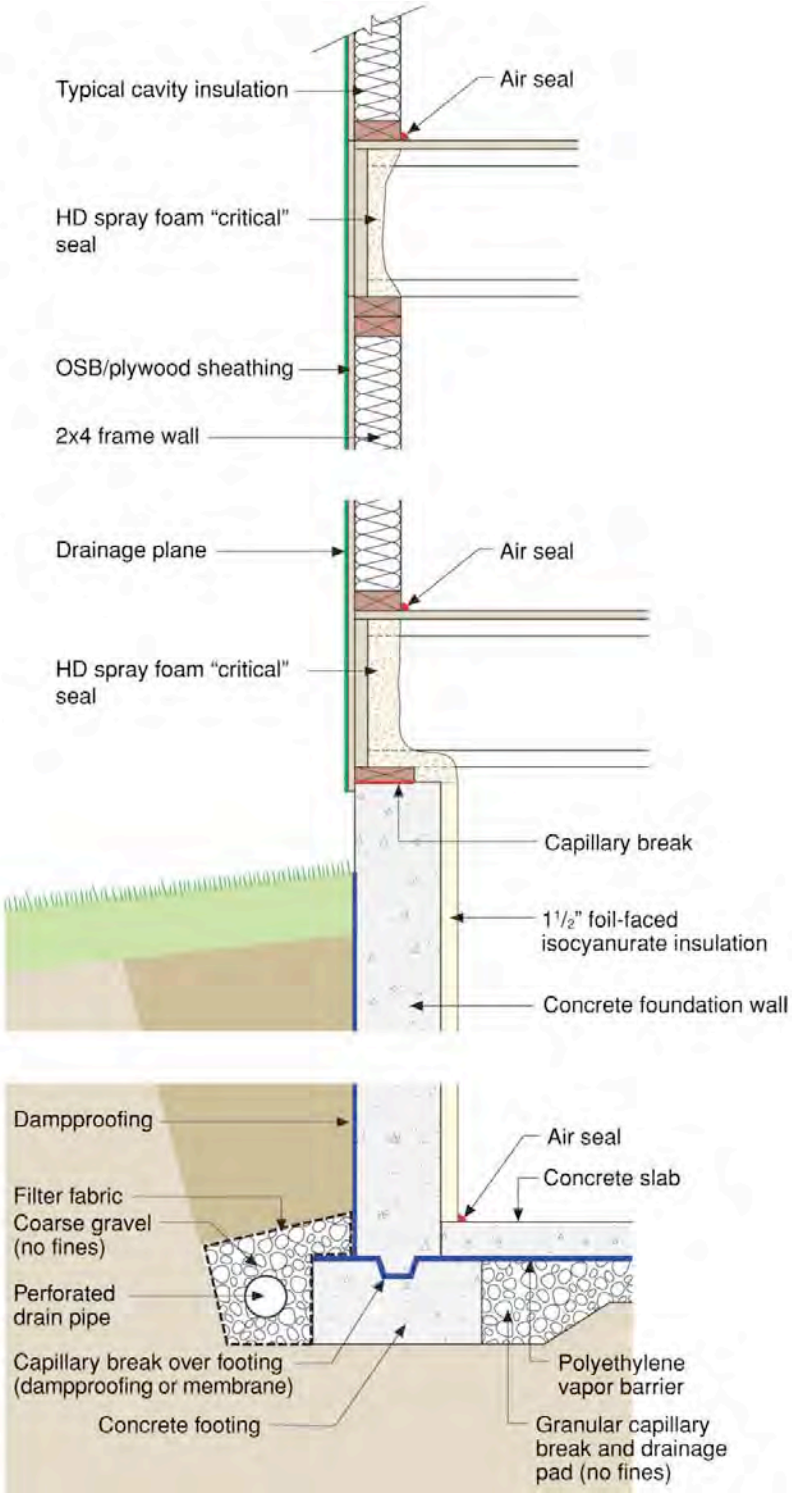


Figure 2.1: Recommended wall and foundation assembly

2.2 Energy Analysis

For the energy analysis of the Greensburg homes, BSC conducted a study using a representative plan and the specifications outlined in the summary table above (see Table 2.1).

Below is a summary of the plan dimensions:

Floor area (sf)	Surface Area (sf)	Volume (cf)	# Beds	# Baths	Glazing Ratio	ASHRAE 62.2 Ventilation Rate
1066	4652	18722	5	3.0	11.5%	55.7 CFM

2.2.1. Peak Loads

A whole house Manual J8 analysis was performed on the residence. The results are below.

Characteristics	Design Heating	Total Cooling	Cooling tons
Base Case	59.5	49.2	5
BSC Case	23.7	13.9	1.5
% Savings	60%	72%	70%

2.2.2. Hourly Energy Simulation

Whole house energy analysis was performed with Energy Gauge USA v. 2.703 from the Florida Solar Energy Commission (FSEC). The spreadsheet below outlines the parametric analysis step by step.

		Total Source Energy Savings (H&C/DHW/Lights/Appliances/Plug)			H&C Source Energy Savings Heating and Cooling		
		Total	Annual	Annual	H and C	H and C	Ht and C
Run ID	Description of upgrade	Savings	Energy cost	Savings	Savings	Energy cost	Annual Savings
0	2008 BA Benchmark	n/a	$2,637	n/a	n/a	$687	n/a
1	Prototype	48.7%	$1,355	$1,282	73.3%	$166	$521

The energy savings have been shown in both total energy savings (which includes heating and cooling) and just heating and cooling. Heating and cooling loads are easier to predict than other loads (such as hot water and miscellaneous electric loads). Thermostat set points have been assumed to be 71°F heating and 76°F cooling for this analysis.

2.2.3. Summary

The house plan build to the proposed technology specification achieves a whole house energy savings of **48.7%** compared to the Building America Benchmark.

3. DEMONSTRATION HOME INCENTIVE PROGRAM

3.1 Description

On a limited, first come, first served basis, BSC arranged for our Building America Industry Partners to provide a material and financial incentive to "jump start" the application of energy efficient construction technology for new houses in Greensburg.

The incentive was provided for 10 homes in Greensburg under the condition that the entire specification be adopted for the construction (see Section 3.2 below) and that the houses be made available for training purposes during the course of the construction.

3.1.1. Industry Partners

BSC arranged for the following Industry Partners to contribute to the Incentive program:

Table 3.1: Industry Partner Contributions

Partner	Contribution
Dow Chemical	1.5" x 4' x 8' STYROFOAM Tongue & Groove or Square Edge (wall sheathing for field of wall) 1" 4' x 8' STYROFOAM Tongue & Groove or Square Edge (wall sheathing over OSB bracing) 2" THERMAX Sheathing (interior of basement walls) 4" or 6" wide Weathermate Straight Flashing 6" wide Weathermate Flexible Flashing 2-7/8" wide Dow Construction Tape Great Stuff Pro Window & Door with gun Great Stuff Pro Gap & Crack with gun Froth-Pak
US GreenFiber	Damp spray cellulose (walls) Loose blown cellulose (attics)

3.2 Specification and Cost Analysis

A $1,600 additional builder construction cost was predicted for the specification package as follows:

3.2.1. Advanced Framing versus Standard Framing

2x6 construction @ 24 inch centers, single plates, no jack studs, no cripple studs, no headers in non load bearing walls, two stud corners, stack framing in place of standard 2x4 framing @ 16 inch centers, double plates, three stud corners, jack studs, cripple studs, headers costs approximately $500 less in materials and approximately $500 less in labor. However, the labor savings is not realized until each framing crew has constructed several houses due to the learning curve. As such, the $500 credit for labor is not included in this cost breakdown.

Cost: ($500 less)

3.2.2. Simplified Ductwork

Single hard ducted central return in place of panned floor joists, and multiple stud cavity returns. The efficiency of the building enclosure allows for a much simpler air distribution system.

Cost: ($500 less)

3.2.3. Insulating Sheathing versus OSB and Housewrap

1.5 inch foam sheathing with taped joints replaces 5/8 inch OSB and Housewrap. The savings on not installing the OSB and Housewrap cover the cost of purchasing and installing the insulating sheathing.

Cost: (wash)

3.2.4. Full Height Basement Insulation

Foil faced foam insulation extending from the top of the basement slab to the top of the concrete foundation wall is an additional cost

Cost: ($750 more)

3.2.5. Additional Cavity Wall Insulation and Roof Insulation

The wall cavity is now 5.5 inches wide rather than 3.5 inches wide and therefore the cavity insulation thickness is increased. The wall cavity goes from R-13 to R-20. Additional ceiling insulation is added – the standard R-40 attic insulation is increased to R-50. The added wall cavity insulation and roof insulation is an added cost

Cost: ($250 more)

3.2.6. Low E Spectrally Selective Windows

These types of windows are already standard practice. For reference purposes they should have an SHGE of less than 0.35 and a U-value of less than 0.3.

Cost: (no change)

3.2.7. Air Sealing

Rim joist critical seal spray foam.

Cost: ($200 more)

3.2.8. 90 plus Condensing Gas Furnace

A standard 80% AFUE gas furnace, 70 kbtu/h input, 56 kbtu/h output, 3-ton coil, single stage, 3-ton coil multi-speed blower (Goodman GMS80703AN) is replaced with a 92.1% AFUE gas furnace, 46 kbtu/h input, 42.8 kbtu/h output, single-stage, 3-ton coil, multi-speed blower (Goodman GKS90453BX). Cost is based on contractor pricing.

Cost: ($200 more)

3.2.9. 2.0 Ton, 16 SEER AC Condensing Unit, R410a

A standard 2.5 ton, 13 SEER AC condensing unit, R22 (Goodman GSC130301) is replaced with a 2.0 ton, 16 SEER AC condensing unit, R410a (Goodman SSX160241). Cost is based on contractor pricing.

Cost: ($475 more)

3.2.10. Tankless Water Heater

A standard natural draft water heater, EF=.56, 40 kbtu/h input, 40 gal (A.O. Smith BFG6140S403NOV) is replaced with an on-demand tankless water heater, EF=.82, 180 kbtu/h input (Rinnai REU-V2520FFUD-91-NG). Cost is based on contractor pricing

Cost: ($575 more)

3.2.11. Controlled Ventilation System

Outside air duct with motorized damper and controlled connected to return side of furnace/air conditioner air handler.

Cost: ($150 more)

3.3 Implementation

The incentive program was introduced through a number of events in and around Greensburg. The following list summarizes many of these events.

- Community Housing Fairs
- A direct letter from the town administration to Greensburg residents
- Communication to residents and builders via third-party organizations, such as FEMA, USDA and Greensburg Greentown
- Training sessions with builders presented by BSC
- Private meetings by BSC and IBACOS with builders and homeowners
- www.buildingamerica-greensburg.com website

Through these events, a number of parties expressed interest in the program. For a number of reasons (outlined in BSC's final report for Task 15.E.3 – TRAINING CURRICULUM AND FOLLOW-UP RESULTS) many construction projects were slow to start and although the interest level was high, no homes were started with the program.

At a builder training session on November 16, 2007, Doug Bruggeman, the construction manager for Mennonite Builders, expressed interests in building all 10 of the houses covered by the program. Mennonite Housing was also participating in the USDA/United Way "Self Help Housing" Program that had been recently launched in co-operation with the City of Greensburg. More information on the Self Help Housing Program is included in an appendix to this report.

The Mennonite Housing was able to start construction of 10 houses in early 2008 and it was agreed that all 10 places in the incentive program would be used for these 10 houses.

4. CONSTRUCTION OF ENERGY EFFICIENT HOMES IN GREENSBURG, KS

4.1 Builder Partner

Mennonite Housing describes their organization in this way:

"Mennonite Housing Rehabilitation Services, Inc., is for people who can not obtain home repair or decent housing in any other way. For over 25 years, our organization has been providing affordable housing options for the low-income and elderly residents of Wichita, Kansas. During its history, Mennonite Housing has built hundreds of new houses and repaired thousands of older homes.

In Greensburg, we identify an immediate need for homes in a community devastated by a natural disaster. The citizens of Greensburg remain strong and possess resolve to rebuild their community. Mennonite Housing is committed to endeavors like Greensburg and will be constructing homes with support many resources."[2]

To construct the houses, Mennonite Housing uses a combination of skilled and unskilled volunteers from around the country. The Self-Help Housing program also provides an opportunity for the homeowner to become involved in the construction of the house. An example of the typical house plan build by the Mennonite Housing in Greensburg is attached as an appendix to this report.

Figure 4.1: Photograph of Self-Help Housing Program board with Dow foil-faced insulation piled behind

[2] Source: http://mhrsi.org/index.php?option=com_content&task=view&id=95&Itemid=155

4.2 Construction Support

4.2.1. Foundations

Each of the houses was constructed with an interior insulated basement (see Figure 4.2 below). The insulation board is carefully taped at all joints and sealed at the bottom of the wall with caulking. The rim joist area is sealed with spray foam insulation from the top of the insulation board to the OSB subfloor.

The foil-faced insulation board, Dow Thermax, is rated for unfinished application, allowing the basements to be insulated but otherwise unfinished. This is an important consideration for affordable house designs.

Figure 4.2: Photograph of basement insulation system

During construction Mennonite Housing found that this foundation assembly could be effectively constructed with volunteer labor.

Figure 4.3: Photograph of floor system at top of foundation wall - this area to receive spray foam air seal.

4.2.2. Framing

All houses were constructed useing advanced 2x6 wall framing with trussed, vented attics and engineered floor joists.

Figure 4.4: Photograph of advanced framed opening in load-bearing wall

Figure 4.5: Photograph of OSB shear panel at corner of advanced frame wall

Figure 4.6: Photograph of complete advanced framing with OSB shear panels.

Figure 4.7: Photograph of OSB shear panel with insulating sheathing over advanced frame wall

Figure 4.8: Photograph of stacked roof and wall framing

Insulating sheathing was specified for these houses to increase the thermal performance of the wall assemblies. Shear strength for the walls was provided by OSB panels at the corners of the house and garage (see Figure 4.5 and Figure 4.6 above).

Joseph Lstiburek from Building Science Corporation conducted several site inspections and training sessions during the framing stage. After the framing of the first two houses, Joe found a number of inconsistencies with the advanced framing details. These issues were explained to the site supervision and corrected on the remainder of the houses. Based on past experience with the implementation of advanced framing details, this learning process was expected.

All houses passed framing inspection without issue.

4.2.3. Water Management

The insulating foam sheathing was detailed as the drainage plane and integrated with window elements using Dow's flashing tape system. Using the mock-up wall assembly constructed in Greensburg by BSC staff, the volunteer builders correctly taped and flashed the sheathing system.

Figure 4.9: Photograph of partially complete window flashing. Pan flashing visible under window.

The cladding system was specified to include 1/4" spacer strips to ensure a proper drainage gap and back-ventilate the cladding (see Figure 4.10 below). The use of 3" strips of Dow "Fan Fold" insulation was an economical means of providing this space.

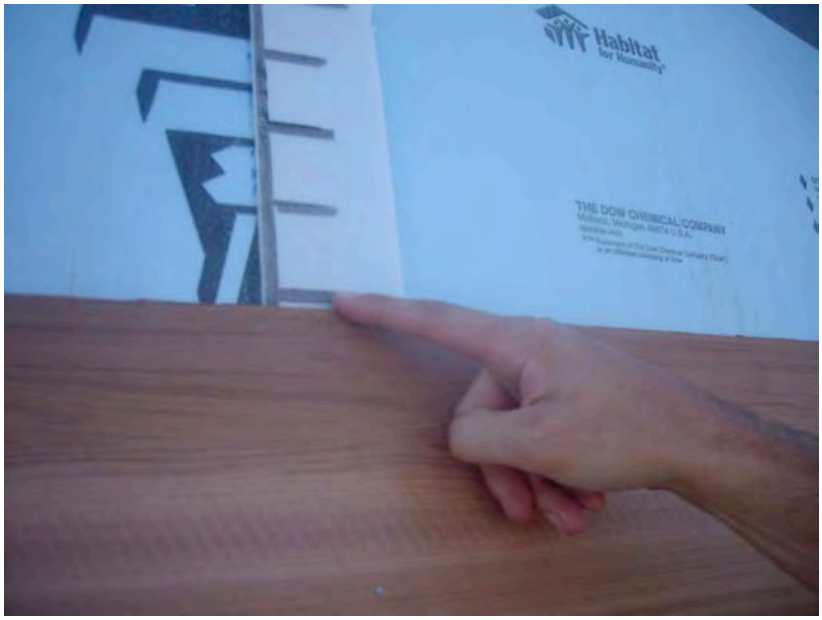


Figure 4.10: Photograph of furring strip for drainage gap and back-venting of siding.

Figure 4.11: Photograph of house exterior with insulating sheathing and windows partially installed. Pan flashing visible where window has not been installed on front of house.

4.2.4. Testing

Testing of a selection of the constructed houses will be carried out by a local HERS rater and/or NREL staff at a later date.

5. ADDITIONAL HOUSING ACTIVITIES

5.1 Green Housing Proposal

Building Science Corporation also participated in DOE/NREL work with a local non-profit organization called Greensburg Greentown.[3] Greensburg Greentown has been involved in a number of "green" projects in the City. BSC and IBACOS provided Greensburg Greentown with a proposal for a performance specification for new homes based on the Building America technology package (see Section 2.1 above) with expanded criteria to achieve a "Silver" rating under the US Green Building Council LEED for Homes program.

The proposal for this specification is attached in an appendix to this report.

5.2 Resources for IBACOS Field Support

BSC also provided information resources for IBACOS' efforts in the field with builders constructing other houses in Greensburg. IBACOS worked to help builders integrate energy efficient technologies. BSC provided Builder's Guides, 2-page High Performance Housing Information Sheets, a full scale example wall assembly (see BSC's final report for Task 15.E.3 – TRAINING CURRICULUM AND FOLLOW-UP RESULTS for more information on these activities), and several smaller construction mock-ups (see Figure 5.1 and Figure 5.2 below).

Figure 5.1: Photograph of two-stud corner with insulating sheathing and trim mock-up

[3] For more information see: http://www.greensburggreentown.org/

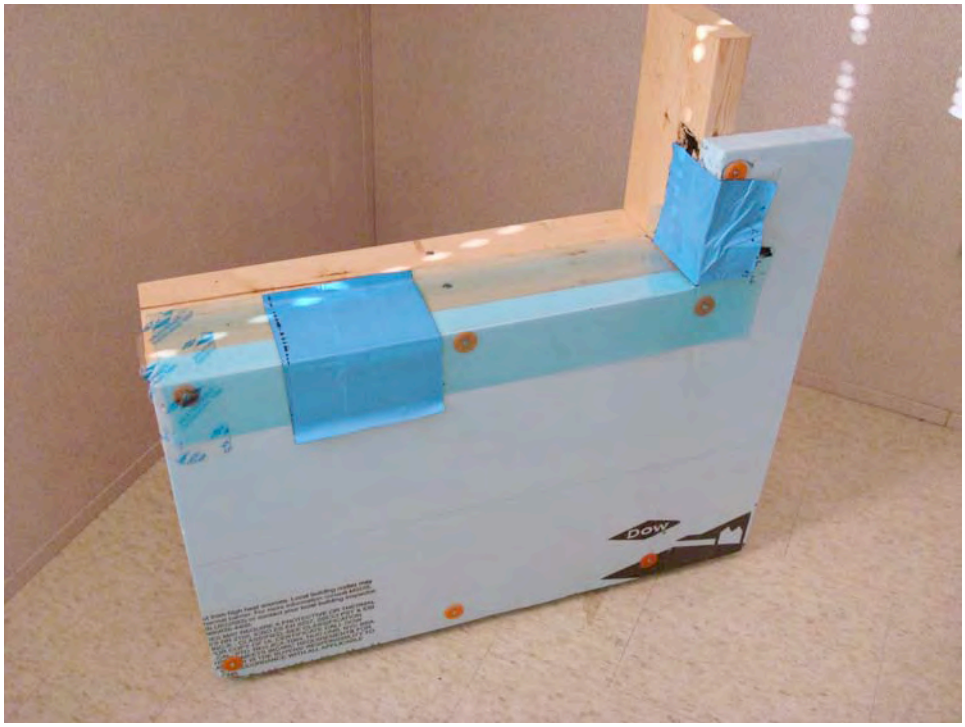


Figure 5.2: Photograph of window pan flashing with insulating sheathing mock-up

6. PROJECT EVALUATION AND CONCLUSIONS

Although BSC expected to develop connections with a greater number of builders in Greensburg, our efforts to support the construction of at least 10 energy efficient houses did result in the construction of more than twenty houses meeting greater than 40 percent whole-house energy savings compared to the BA Benchmark.

The successful co-ordination of support from Industry Partners working with BSC's Building America research consortium aided in the acceptance of the proposed technology package. The approach demonstrated performance benefits and cost savings such that the development group (Mennonite Housing) has adopted the technology for all of their projects in Kansas.

7. APPENDICES

7.1 BSC Building America Energy Analysis Report

7.2 Demonstration Home Incentive Program Offer

7.3 USDA/United Way Self Help Housing Program Description

7.4 Mennonite Builders Example House Plan

7.5 Greensburg Green Housing Proposal

August 26th, 2008

To: Joseph Lstiburek, Ph. D., P. Eng. (Building Science Corporation)

From: Philip Kerrigan Jr., PE (Building Science Corporation)

Re: Mennonite Housing Building America Analysis for a single story plan with basement

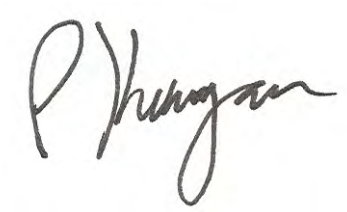
Joe,

I completed a 2008 Building America performance analysis on the single story plan with basement that you submitted to me on August 15th, 2008. A simulation was performed comparing the BA Benchmark to the specifications that you provided to me on August 26th, 2008.

Total energy use is reduced by 48.7% vs. the Building America Benchmark.

If you have any questions you can email me at phil@buildingscience.com or call 617 800 2633 extension 222.

Sincerely,



Philip Kerrigan Jr., PE
Building Science Corporation

Cc: Betsy Pettit, AIA (Building Science Corporation)

Characteristics and Dimensions

Below are the characteristics for both the base case and the BSC design.

	BA Benchmark Design	Proposed BSC Design
Building Enclosure		
Roof	Composition Shingles	Composition Shingles
Ceiling	R-33 at flat ceiling plane	R-50 flat attic
Walls	R-14 2x6 16" o.c. (frame wall)	R-19 2x6 24" o.c. OVE + R-7.5 XPS
Foundation	R-8.7 basement wall	R-14 basement wall
Windows	Aluminum clad wood with clear laminated glass (U=0.94, SHGC=0.74)	Vinyl clad double glazed spectrally selective, gas filled (U=0.30, SHGC=0.26)
Infiltration	0.33 nACH	1.5 sq in leakage area per 100 sf envelope
Mechanical systems		
Heat	78% AFUE furnace in vented attic	92% AFUE furnace in conditioned basement
Cooling	10 SEER split system	14 SEER split system in conditioned basement
DHW	Standard Tank Hot Water EF=0.54	Sealed combustion tank water heater (EF=0.62)
Ducts	R-8 flex runouts in basement	R-8 flex runouts in conditioned basement
Leakage	Average duct tightness (15%)	none to outside (5% or less)
Ventilation	62.2 CFM rate (55.7 CFM)	Central Fan Integrated Supply Ventilation
Lighting	86% Incandescent	100% Energy Star CFL
Appliances	standard appliances	Energy Star fridge, DW, clothes washer

Note: Electricity rate is 11 cents/kWh
Natural Gas is $1.23/therm

Below is a summary of the Maas House dimensions:

Floor area (sf)	Surface Area (sf)	Volume (cf)	# Beds	# Baths	Glazing Ratio	ASHRAE 62.2 Ventilation Rate
1066	4652	18722	5	3.0	11.5%	55.7 CFM

Peak Loads

A whole house Manual J8 analysis was performed on the Mass house using Energy Gauge version 2.703. The results are below.

Characteristics	Design Heating	Total Cooling	Cooling tons
Base Case	59.5	49.2	5
BSC Case	23.7	13.9	1.5
% Savings	60%	72%	70%

Hourly Energy Simulation

Whole house energy analysis was performed with Energy Gauge USA v. 2.703 from the Florida Solar Energy Commission (FSEC). The spreadsheet below outlines the parametric analysis step by step.

		Total Source Energy Savings (H&C/DHW/Lights/Appliances/Plug)			H&C Source Energy Savings Heating and Cooling		
Run ID	Description of upgrade	Total Savings	Annual Energy cost	Annual Savings	H and C Savings	H and C Energy cost	Ht and C Annual Savings
0	2008 BA Benchmark	n/a	$2,637	n/a	n/a	$687	n/a
1	Prototype	48.7%	$1,355	$1,282	73.3%	$166	$521

The energy savings have been shown in both total energy savings (which includes heating and cooling) and just heating and cooling. Heating and cooling loads are easier to predict than other loads (such as hot water and miscellaneous electric loads). Thermostat set points have been assumed to be 71°F heating and 76°F cooling for this analysis.

Additional qualifications:

This plan receives an Energy Star Index of 59, which qualifies it for the DOE Builder's Challenge.

Finally, according to the Federal Tax Credit report below this plan qualifies for the $2000 tax credit.

Tax Credit Certification Report

PROJECT

Title:	KS Greensburg Haas Proto	Family Type:	Single-family	AdressType:	StreetAddress
Building Type:	User	New/Existing:	New (From Plans)	Lot #	2 B1
Owner:		Bedrooms:	5	SubDivision:	tRaOT
# of Units:	1	Conditioned Area:	1066	PlatBook:	
Builder Name:		Total Stories:	1	Street:	
Permit Office:		Worst Case:	No	County:	
Jurisdiction:		Rotate Angle:	0	City, State, Zip:	,
Comment:	BA House				OK ,

QUALIFICATION CRITERIA

Energy Use:

	Qualifying Home	Reference Home
Cooling Energy	4.31 MBtu*	15.46 MBtu
Heating Energy	13.00 MBtu*	32.54 MBtu
Total	17.31 MBtu	48.00 MBtu
Total Energy Use Savings =	63.93 %	

Envelope:

	Qualifying Home	Reference Home
Cooling Loads	4.90 MBtu	15.46 MBtu
Heating Loads	17.89 MBtu	32.54 MBtu
Total	22.80 MBtu	48.00 MBtu
Total Envelope Savings =	52.50 %	

All homes may qualify for a $2,000 federal tax credit to the builder if their heating and cooling energy use has been reduced by 50% or more and the home has achieved envelope savings of 10% or more. HUD Code manufactured homes may also qualify for a $1,000 tax credit to the manufacturer if their heating and cooling energy use has been reduced by 30% or more and the home has achieved envelope savings of 10% or more.

* Energy uses determined in accordance with RESNET Publication No. 06-001, "Procedures for Certifying Residential Energy Efficiency Tax Credits for New Homes."

Heating and cooling energy and cost savings have been calculated in the manner prescribed in section 2.02 of IRS Notice 2006-27. Field inspections of the dwelling unit (or of other dwelling units using the sampling protocol found in the current ENERGYSTAR for Homes Sampling Protocol Guidelines) performed by the eligible certifier during and after the completion of the construction have confirmed that all features of the home affecting such heating and cooling energy consumption comply with the design specifications provided to the eligible certifier.

Description of Demonstration Home Incentive Program and Specification

Why Should Greensburg Land Owners Rebuild Energy Efficiently?

The US Department of Energy's (DOE) Building America program has demonstrated that a 40 percent reduction in total energy consumption over a comparable new home constructed to the 2003 International Energy Conservation Code (IECC). This is practical, recommended, and financially advantageous to Greensburg land owners who wish to rebuild single family homes.

The additional construction cost to achieve the 40 percent savings for a typical 1,500 ft2 wood frame house with full house wrap and OSB sheathing on a concrete basement foundation in Greensburg, KS is approximately $1,600. The cost to rate this house (i.e. an "energy rater" comes to the house and "tests" the house and provides a "rating") in order to receive a $2,000 Federal tax credit is approximately $400. In other words it costs a builder $2,000 ($1,600 plus $400) to receive a $2,000 tax credit.

The monthly utility bill savings that are realized with this type of construction are approximately $35. So it should cost the land owner "nothing" to realize a monthly savings of $35 per month if the builder passes on the savings the builder realizes with the tax credit.

Additional utility bill savings can be achieved by using Energy Star appliances and compact fluorescent lighting. The additional cost of an Energy Star washer and Energy Star gas dryer over that of a standard washer and gas dryer is approximately $750. There is no cost difference for purchasing an Energy Star dishwasher. In fact is almost impossible to get a non Energy Star dishwasher. There is an additional cost to purchase or install compact fluorescent light fixtures and lights above standard practice – this is typically around $250. The extra $1,000 for the appliances and lighting package can be financed for approximately $7.50 per month. The energy savings associated with the use of these appliances is approximately $10 to $15 per month yielding a monthly savings to the land owner.

The technology and strategies to get 40% savings are proven, simple and elegant. They have been developed by the Building America Program, a joint DOE and National Renewable Energy Laboratory (NREL) initiative, over the previous decade to prepare America for what we all believe will be a challenging energy future. But the technology is "different" and different "things" are never easy to adopt or apply. Most builders, with good cause, view different things as "risky". This is true for all new technologies. Most purchasers often view new technologies as "too good to be true", and for good reason.

The Building America Program is designed to help both the builder and the purchaser with reliable "information", "knowledge" and "experience" – and to act as an "honest broker" for this information and technology. Building Science Consulting (BSC) and IBACOS are working with NREL in Greensburg to support the rebuilding effort. These two Building America teams do not make money by "selling" things. Each team's role is to provide proven information and provide vetted technical support.

The approach and technologies recommended also must make cost sense.

BSC and IBACOS are both working in Greensburg can and will provide the technical support, help, guidance, advice, training, supervisory help directly to the builder to help the builder implement the technologies outlined in the previous letter. Additionally, BSC and IBACOS can and will work with individual builders and land owners to design specific plans and develop specific specifications to implement the technology outlined in the previous letter. A full scale "mock-up" of the recommended wall assembly can be seen at the USDA trailer park just down the street from the city offices.

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On a limited, first come, first served basis, the Building America teams can provide a material and financial incentive to "jump start" the application of the technology.

The first ten land owners or builders who wish to be supported by the Building America teams can receive the following from our Building America partners:

All of the exterior foam sheathing and basement insulation (value to the builder $1,750)

All of the wall cavity insulation (cellulose) and roof insulation (value to the builder $750)
The difference in cost between standard furnaces, air conditioners and hot water heaters and the equipment recommended in the previous letter (value to the builder $1,400).

This list totals $3,800 in value. This is money that the builder does not have to spend to construct the type of house described in the previous letter. This offsets the extra $1,600 the builder needs to spend (so the builder ends up ahead $2,200).

What does the land owner get? The land owner gets a great house for no additional cost. Can a builder pass on some (or all) of the cost incentive and savings to the land owner? That is up to the land owner and builder to work out themselves.

There is a catch. There always is. The deal is that this is an all or nothing thing. The technologies can't be "cherry picked". A builder or land owner can not come to the Building America teams and ask for only the foam sheathing and the equipment without also agreeing to the advanced framing, the simplified duct distribution system, the air sealing, the controlled ventilation, the compact fluorescent lighting and the Energy Star appliances and all the training and support. This is a "systems" thing, or "holistic" thing. The "whole" thing or package works together better than each individual piece.

And there is more. We want the folks who participate to talk about this. Make the home available for the neighbors to see. Not all the time, but a couple of weekends at the end of construction – say two weekends. The Building America teams will come and be on hand to answer questions and bring coffee and donuts and a smile. And the builder will take his bows and be justifiably proud. And the land owner? A grin from ear to ear. And we hope that this will encourage others to do the same thing because it all makes sense on the merits without incentives – it just makes sense period.

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The $1,600 additional builder construction cost that was stated in the beginning of this letter is broken down as follows:

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2x6 construction @ 24 inch centers, single plates, no jack studs, no cripple studs, no headers in non load bearing walls, two stud corners, stack framing in place of standard 2x4 framing @ 16 inch centers, double plates, three stud corners, jack studs, cripple studs, headers costs approximately $500 less in materials and approximately $500 less in labor. However, the labor savings is not realized until each framing crew has constructed several houses due to the learning curve. As such, the $500 credit for labor is not included in this cost breakdown.

($500 less)

Simplified Ductwork
Single hard ducted central return in place of panned floor joists, and multiple stud cavity returns. The efficiency of the building enclosure allows for a much simpler air distribution system.

($500 less)

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1.5 inch foam sheathing with taped joints replaces 5/8 inch OSB and Housewrap. The savings on not installing the OSB and Housewrap cover the cost of purchasing and installing the insulating sheathing.

(wash)

Full Height Basement Insulation
Foil faced foam insulation extending from the top of the basement slab to the top of the concrete foundation wall is an additional cost

($750 more)

Additional Cavity Wall Insulation and Roof Insulation
The wall cavity is now 5.5 inches wide rather than 3.5 inches wide and therefore the cavity insulation thickness is increased. The wall cavity goes from R-13 to R-20. Additional ceiling insulation is added – the standard R-40 attic insulation is increased to R-50. The added wall cavity insulation and roof insulation is an added cost

($250 more)

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(no change)

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($200 more)

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($200 more)

2.0 Ton, 16 SEER AC Condensing Unit, R410a
A standard 2.5 ton, 13 SEER AC condensing unit, R22 (Goodman GSC130301) is replaced with a 2.0 ton, 16 SEER AC condensing unit, R410a (Goodman SSX160241). Cost is based on contractor pricing.

($475 more)

Tankless Water Heater
A standard natural draft water heater, EF=.56, 40 kbtu/h input, 40 gal (A.O. Smith BFG6140S403NOV) is replaced with an on-demand tankless water heater, EF=.82, 180 kbtu/h input (Rinnai REU-V2520FFUD-91-NG). Cost is based on contractor pricing

($575 more)

Controlled Ventilation System
Outside air duct with motorized damper and controlled connected to return side of furnace/air conditioner air handler.

($150 more)

Summary: Table 1 – Total Energy Efficiency Package Cost

Efficiency Upgrade	**Estimated Incremental Cost**
Energy Star Appliances	+$750
Compact Fluorescent Lighting	+$250
Total Incremental Cost	$1000

Summary: Table 2 – Builder Incremental Cost With Tax Credit

	Estimated Incremental Cost
Builder Incremental cost (Excluding Appliances and Lighting)	+$1600
Rating for Tax credit certification	+400
Builder Tax Credit	-$2000
Total Incremental Builder Cost	-0-

Coming Home to Greensburg

The City of Greensburg

Invites You To Celebrate
the Completion of 10 Self-Help Homes
for Greensburg Families
and to
Welcome Our Families Back Home

November 16, 2008 @ 2:00 pm
Ribbon Cutting Event at 117 West Colfax

Self-Guided Home Tours Follow Event

Food and Refreshments Will Be Served at
Prairie Point Townhomes
408 South Main
beginning at 1:00 p.m.

Self-Help Homes:

Michele Mayes	*117 W Colfax*	*Open*
Wayne & Virginia Burnham	*623 S Grove*	*Open*
Christy Pyatt	*701 S Grove*	*Open*
Alan Todd	*507 S Grove*	*Open*
Tami Raber	*210 W Morton*	*Open*
Robert Koehn	*612 Iowa Lane*	
Richard & Frieda Figg	*325 S Spruce*	
Vicky Weaver	*318 S Olive*	
Stephanie Ralstin	*312 S Cherry Drive*	
Irma Morton	*318 S Cherry Drive*	

To learn more about Self-Help Housing opportunities contact:

Mennonite Housing
Byron Adrian
badrian@mhrsi.org
316-942-4848

The following Partners have made significant contributions of their Time, Talents, Expertise, Products and/or Innovative Solutions to the Greensburg Community Self-Help Housing Program:

- City of Greensburg
- USDA Rural Development
- United Way of the Plains
- Kansas Housing Resource Corp.
- Mennonite Housing-Wichita
- SC Kansas Tornado Recovery Organization
- South Central Community Foundation
- National Association of Home Builders (Wichita)
- The Salvation Army
- FHLBank Topeka
- Catholic Social Services
- American Red Cross
- Greensburg State Bank / Hudson Oil Foundation
- Community Housing Service
- Greensburg GreenTown
- U.S. Department of Energy
- National Renewable Energy Lab
- Integrated Building and Construction Solutions (IBACOS)
- Kiowa County Commission
- Building Science Corporation
- Dow Chemical & Green Fiber
- Greensburg Self-Help Families
- Dedicated Volunteers from Across the Nation

Special Thanks

We want to take this opportunity to express a special Thank You to:

- ***U.S. Senator Pat Roberts***
- ***U.S. Senator Sam Brownback***
- ***U.S. Congressman Jerry Moran***

for their leadership and support in securing the supplemental funding to allow for the creation of the Greensburg Community Self-Help Housing Program.

USDA Announces Self-Help Housing Program

FOR IMMEDIATE RELEASE – November 19, 2007 Contact- Harold Alford (785) 271-2701

Greensburg 'Community Self-Help Housing Program' Announced

Affordable Housing Program To Assist Returning Residents

Greensburg, KS – USDA Rural Development State Director Chuck Banks was joined this evening by Greensburg City Administrator Steve Hewitt, along with United Way of the Plains President Patrick J. Hanrahan and Mennonite Housing Rehabilitation Services President & CEO Andy Bias, in announcing an innovative new affordable housing program for the community. USDA Rural Development and the United Way's funding, collectively totaling up to $400,000, will allow the City of Greensburg to work with Mennonite Housing Rehabilitation Services to oversee the construction of affordable single-family homes for residents returning to the community.

"USDA Rural Development is very pleased to partner with the United Way of the Plains and Mennonite Housing Rehabilitation Services to assist Greensburg to create this community self-help housing program. Residents returning to Greensburg need affordable housing, and this innovative partnership and resulting funding will allow the City to assist its residents in achieving this very important long-term recovery goal," remarked USDA Rural Development State Director Banks. "This 'Community Self-Help Housing Program', modeled after USDA's successful *Mutual Self-Help Housing Program,* will also include other non-profits and faith-based organizations to help reduce the cost of the houses that will be built to replace those homes lost from the

devastating May 4th tornado that struck the Greensburg area."

City Administrator Steve Hewitt commented, "On behalf of the City of Greensburg, we are pleased to support the Community Self-Help Housing Program. As a community one of our biggest challenges is affordable housing. This program under the partnership between the City of Greensburg, USDA, and others such as Mennonite Housing, United Way, and many more gives our community a great resource to rebuild and grow."

USDA Rural Development low-interest loans will also be used to provide financing for the homes' mortgage. The Agency recently was approved to receive additional low-interest loan and grant funding to support the financing of new affordable homes and home repairs, along with workforce and senior rental housing in Kiowa County and other FEMA-designated counties in Kansas. Individuals interested in learning more about the Greensburg 'Community Self-Help Housing Program' are encouraged to contact the Agency at 785-271-2718 or at tim.rogers@ks.usda.gov.

Additional partners who will be contributing in this affordable housing construction effort are Greensburg – Greentown; Kansas Housing Resources Corporation; FHLBank Topeka; South-central Kansas Community Foundation; South-central Kansas Tornado Recovery Organization; and Community Housing Services, Inc.

USDA Rural Development's mission is to deliver programs that support increasing economic opportunities and enhancing the quality of life for rural Americans. As a venture capital entity, USDA Rural Development provides equity and technical assistance to finance and foster growth in homeownership, business development, and critical community and technology infrastructure in rural America. Since 2001, USDA Rural Development has invested over $1.2 billion in funding to expand single family homeownership, multi-family and senior rental housing, community facilities, economic development, water and waste disposal, renewable energy and energy efficiency, telecommunications, and value-added producer programs across Kansas. Agency funding has benefited over one million Kansans

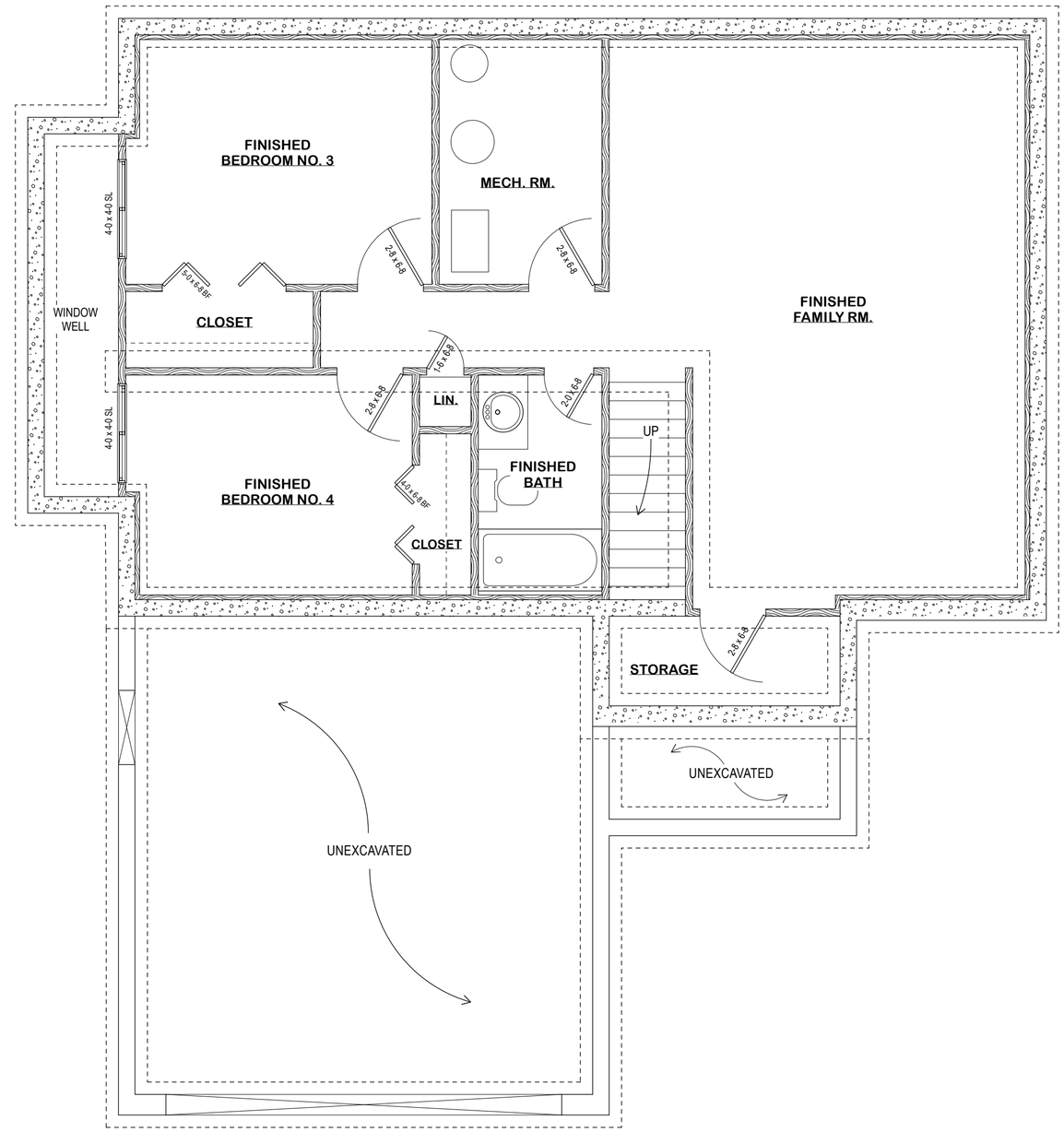
during this period, and will support more than $5.5 billion in future economic development in Kansas.

For additional information regarding USDA Rural Development programs, interested parties may call the Agency's state headquarters at 785-271-2700 or log onto the state's USDA Rural Development website at: www.rurdev.usda.gov/ks

USDA Rural Development – ***Committed to the Future of Rural Communities.***

PROJECT DATA

GENERAL NOTES



BASEMENT AND FOUNDATION PLAN

0 2' 4' 8'

1/4" = 1'-0"

Mennonite Housing

Mennonite Housing Rehabilitation Services, Inc.

Bridget Bailey
Plan #943B
Wichita, Kansas

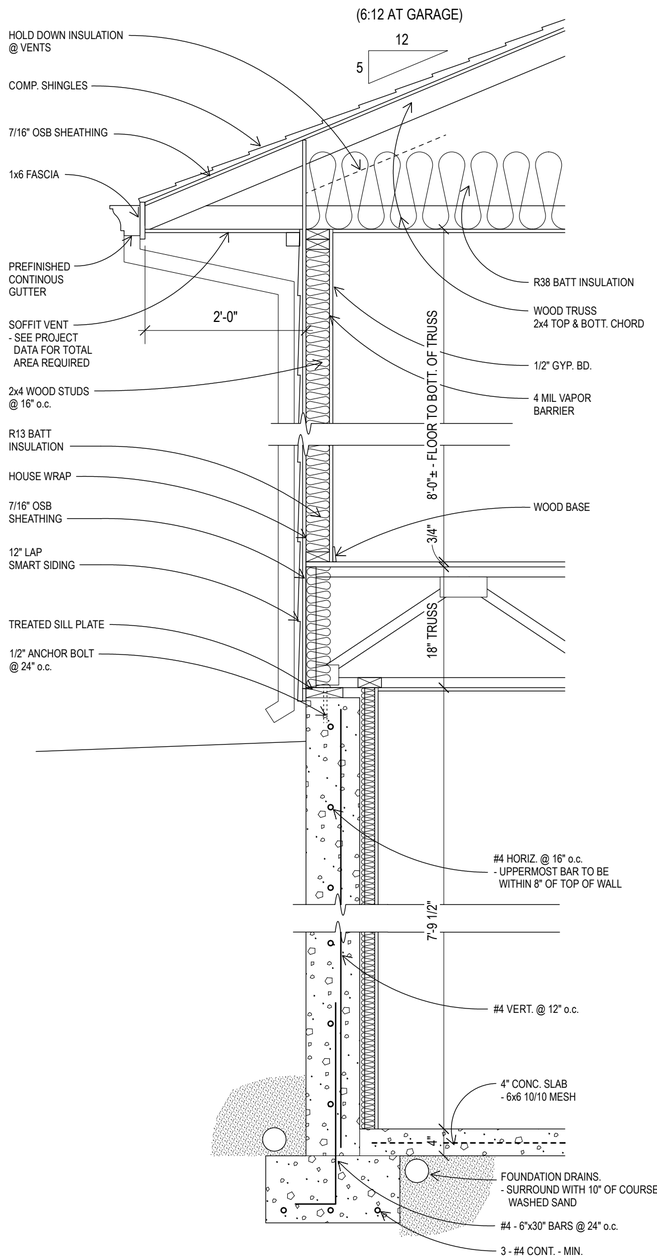
BASEMENT & FOUNDATION PLAN

SHEET A1

FILE NO.: 0712
DATE: 07-26-07
DR. BY: R.M.C.
CK. BY:

REVISIONS:

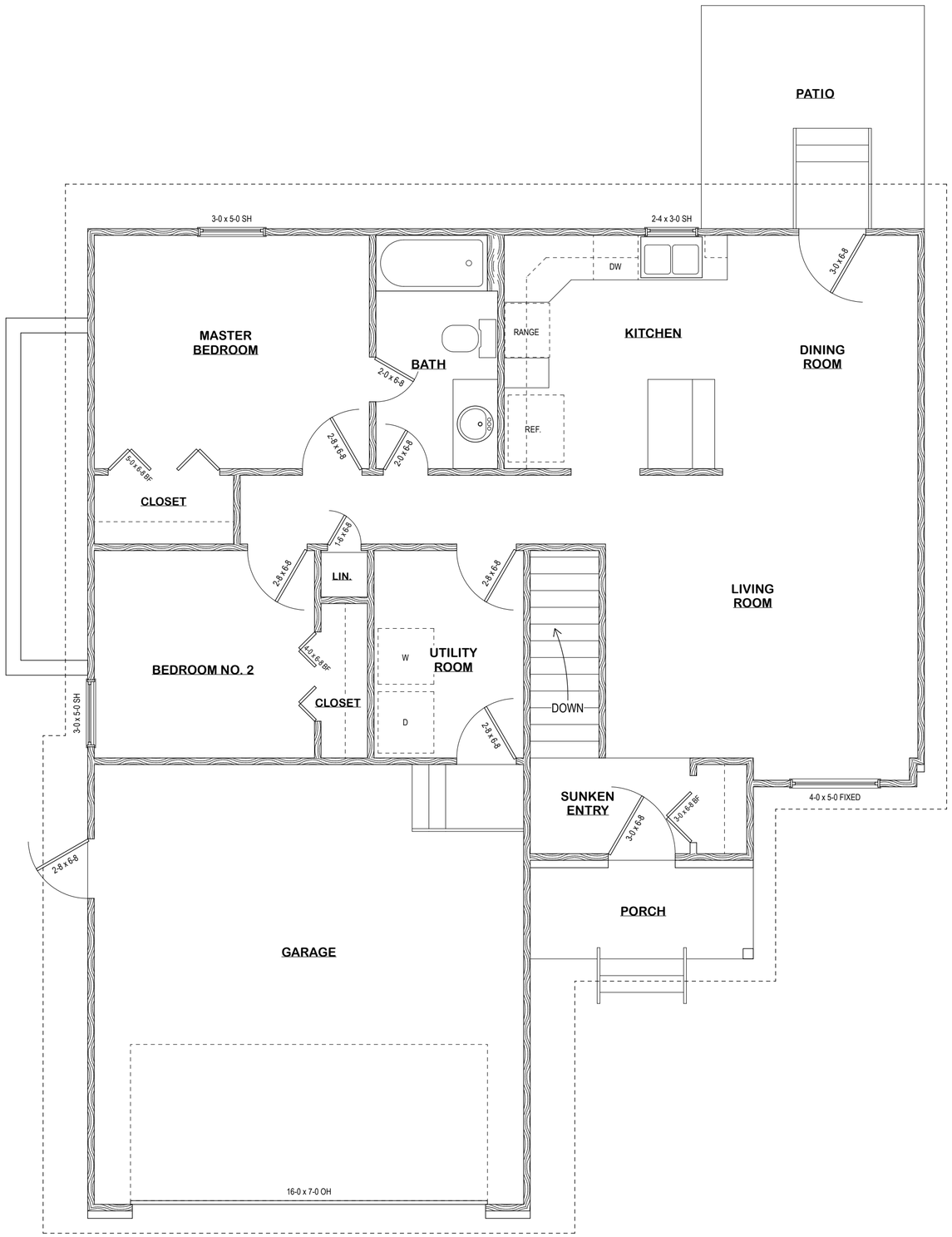
RICHARD B KRAYBILL ARCHITECT
230 LAURA
WICHITA, KANSAS 67211
316-263-0721
FAX-263-2080
WWW.KRAYBILLARCHITECT.COM



WALL SECTION

0 1' 2' 4'

3/4" = 1'-0"



FIRST FLOOR PLAN

0 2' 4' 8'

1/4" = 1'-0"

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Mennonite Housing Rehabilitation Services, Inc.

Bridget Bailey
Plan #943B
Wichita, Kansas

FIRST FLOOR PLAN

SHEET A2

FILE NO.: 0712
DATE: 07-26-07
DR. BY: R.M.C.
CK. BY:

REVISIONS:

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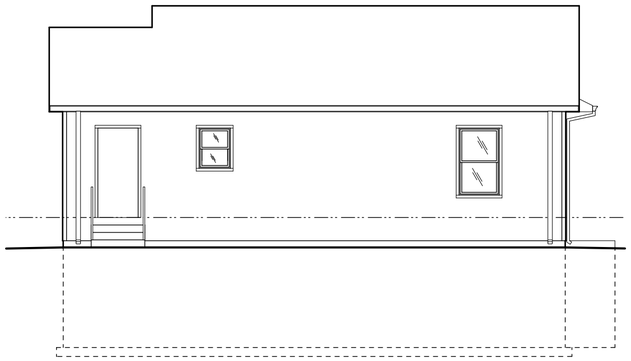
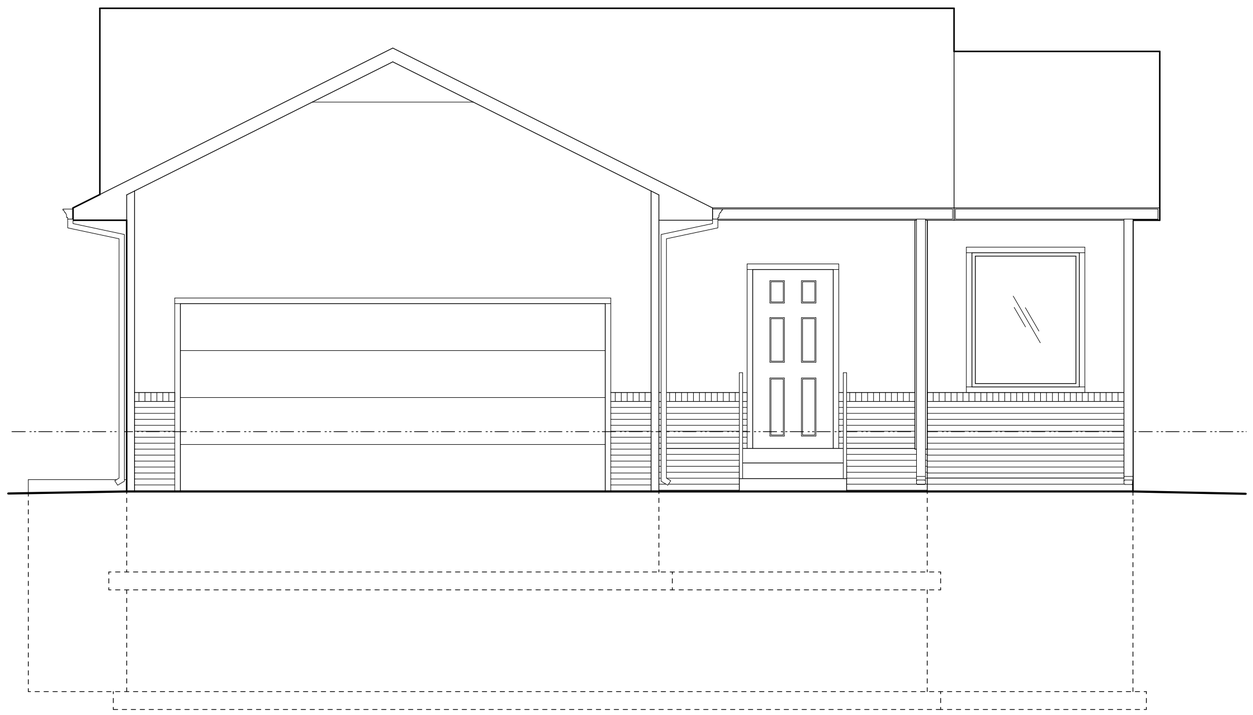


REAR ELEVATION

0 4' 8' 16'

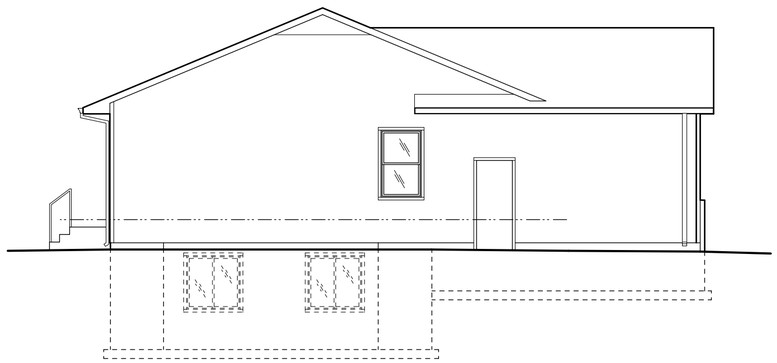
1/8" = 1'-0"



FRONT ELEVATION

0 2' 4' 8'

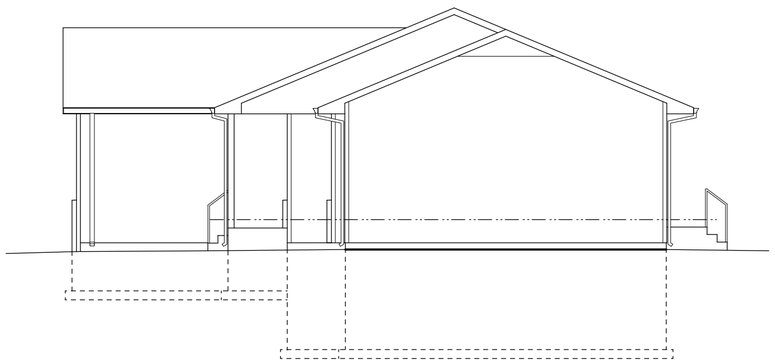
1/4" = 1'-0"



LEFT ELEVATION

0 4' 8' 16'

1/8" = 1'-0"



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October 19, 2007

To: Daniel Wallach,

Re: DOE/NREL/Building America Proposal for Self-Help Green Home Building in Greensburg, KS

Daniel,

Building America teams have been involved in developing many of the techniques, standards, and resources referenced by national green building programs (and have been involved in the development of some of the programs themselves). In Greensburg, we would be happy support efforts to construct Green Homes with the USDA/United Way Self Help Housing Program.

Through work with Industry and Builder Partners, we've had extensive experience with implementing green building techniques and technologies into the residential building process – in design, construction, commissioning, marketing and performance monitoring. Through Building America's focus on production builders, we've had to pay particular attention to overcoming the limitations in experience, skill, knowledge, vision, logistics etc. (shared by all players in the industry) that often stand in the way of transitioning to more environmental appropriate construction practices.

BSC and IBACOS have worked with Habitat for Humanity in many locations around the country. BSC has house plans originally developed for Habitat volunteer builds that have been modified for Greensburg, KS. Examples are attached.

Also attached is an outline of the green attributes of a house built to the Building America 40% package proposed for our Demonstration Home Incentive Program prepared using the US Green Building Council's LEED for Homes rating system. I have included notes to indicate how we would expand on this package to achieve a higher LEED-H rating.

We think that this specification would be an affordable and buildable base for the USDA/United Way Program and would provide a rallying point for the contributions of other organizations in contact with Greensburg Greentown.

Finally, I have also included a description of the additional support that would be provided through DOE/NREL/Building America, including design review energy analysis of other house plans, on-site technical support, and training for volunteer builders.

Best regards,

Alex Lukachko
Building Science Corporation

Attachments:

- Description of Demonstration Home Incentive Program and Specification
- Description of Building America Green Characteristics and Recommendations
- LEED for Homes Checklist for Sample BSC House Plans
- BSC Building America Greensburg House Prototypes
- Residential Energy Efficiency Resources Available from DOE

Description of Demonstration Home Incentive Program and Specification

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($475 more)

Tankless Water Heater
A standard natural draft water heater, EF=.56, 40 kbtu/h input, 40 gal (A.O. Smith BFG6140S403NOV) is replaced with an on-demand tankless water heater, EF=.82, 180 kbtu/h input (Rinnai REU-V2520FFUD-91-NG). Cost is based on contractor pricing

($575 more)

Controlled Ventilation System
Outside air duct with motorized damper and controlled connected to return side of furnace/air conditioner air handler.

($150 more)

Summary: Table 1 – Total Energy Efficiency Package Cost

Efficiency Upgrade	**Estimated Incremental Cost**
Energy Star Appliances	+$750
Compact Fluorescent Lighting	+$250
Total Incremental Cost	$1000

Summary: Table 2 – Builder Incremental Cost With Tax Credit

	Estimated Incremental Cost
Builder Incremental cost (Excluding Appliances and Lighting)	+$1600
Rating for Tax credit certification	+400
Builder Tax Credit	-$2000
Total Incremental Builder Cost	-0-

Description of Building America Green Characteristics and Recommendations

Building America and Green Building

Although, the goals are the Building America research program are a subset of those typically addressed by green building standards, our focus on energy efficiency, resources efficiency, occupant safety, health, and comfort, and durability is strongly compatible with those standards. As an example, I have attached a preliminary (and unofficial) LEED for Homes scorecard based on a 1200 sq ft, 3-bedroom house using the specification developed for our demonstration house incentive program (see "Description of Demonstration Home Incentive Program and Specification"). Please note that the residential LEED program is significantly different that the programs used for commercial buildings and neighborhoods.

Without considering the majority of the "Location and Linkages" and "Sustainable Site" credits (because the town planning has not been completed and the site conditions may vary), as well as the "Water Efficiency" and the "Awareness and Education" credits (with the exception of the prerequisites), the Building America demonstration house itself would achieve a Certified rating. This is shown on the attached scorecard.

Adding on to the Demonstration Home Specification

The sections that I did not include in this tally are those not typically addressed by the Building America program. However, the house specification could be built upon to address the LEED-H sections that I have excluded to reach the Silver and Gold rating level.

Starting with the estimated Certified rating (36 points), here's a start on how that would work:

Innovation and Design Process (+5 points)

- 2 points for design and planning as an integrated team
- 3 points for durability inspection relying on Building America's core work with durability planning

Location and Linkages (+8 points)

- 8 points in total for re-construction within an urban setting

Sustainable Sites (+6 points)

- 6 points through working with a Landscape Architect to develop basic specification for landscaping around each house. This would include a planting schedule, tree plan, and consideration for the permeability of the site.

Water Efficiency (+5 points)

- 2 points for rain water harvesting system – donation of system to be arranged
- 3 points for high efficiency toilets, showers, and faucets – donations of dual-flush toilets would be an example

Energy and Atmosphere

- addressed in Building America Demonstration Program specification
- possible additional points for including on-site renewable energy generation (e.g., photovoltaics or solar hot water – BSC, IBACOS and NREL have extensive experience with both)

Materials and Resources (+8 points)

- addressed in Building America Demonstration Program specification (advanced framing and construction waste)
- 8 points for Environmentally Preferable Products – there will be many manufacturers who will partner with Greensburg Greentown to provide these products both for interior finishes and construction materials.

Indoor Environmental Quality (+4 points)

- addressed in Building America Demonstration Program specification
- 4 points for additional measures, including additional testing and mechanical equipment – likely through partnering with EPA ENERGY STAR Raters and Industry Partners

Awareness and Education (+2 points)

- 2 points for public awareness and education work done by Greensburg Greentown

The estimated total would be 36 points for the Building America Demonstration Home Program and 38 additional points for green building measures arranged through the Greensburg Greentown and DOE/NREL/Building America partnership with other interested parties. 74 points would put these houses well into the Gold certification level of LEED for Homes.

Of course, the notes above are an estimate only and assume that the additional costs can be defrayed by donations and a lot of hard work on the part of Greensburg Greentown. Obviously there are many exciting opportunities for partnerships here. Having these extra efforts organized around the Building America core proposal will expedite the process and ensure that the basic houses themselves are affordable and buildable.

Project Checklist

LEED for Homes

Builder Name:	***Sample Building America House***
Home Address (Street/City/State):	***Greensburg, KS***

Input Values: No of Bedrooms: *3* Floor Area (SF): *1200*

Minimum No. of Points Required: Certified: *36* Silver: *51* Gold: *66* Platinum: *81*

Detailed information on the measures below are provided in the companion document "LEED for Homes Rating System"

Y / Pts	No	N/A							***Max Points Available***
Innovation and Design Process (ID)						(Minimum of 0 ID Points Required)			**9**
y				1.1	**Integrated Project Planning**	Preliminary Rating			Prerequisite
1				1.2		Integrated Project Team			1
				1.3		Design Charrette			1
y				2.1	**Quality Management for**	Durability Planning; (Pre-Construction)			Prerequisite
y				2.2	**Durability**	Wet Room Measures			Prerequisite
y				2.3		Quality Management			Prerequisite
3				2.4		Third-Party Durability Inspection			3
				3.1	**Innovative / Regional Design**	Provide Description and Justification for Specific Measure			1
				3.2		Provide Description and Justification for Specific Measure			1
				3.3		Provide Description and Justification for Specific Measure			1
				3.4		Provide Description and Justification for Specific Measure			1
4				Sub-Total					
Y / Pts	No	N/A							
Location and Linkages (LL)						(Minimum of 0 LL Points Required)	OR		**10**
HOLD				1	**LEED-ND Neighborhood**		**LL2-5**		10
				2	**Site Selection**	Avoid Environmentally Sensitive Sites and Farmland	**LL1**		2
				3.1	***Preferred Locations***	Select an Edge Development Site	**LL1**		1
				3.2	***OR***	Select an Infill Site	**LL1**		2
				3.3		Select a Previously Developed Site	**LL1**		1
				4	**Infrastructure**	Site within 1/2 Mile of Existing Water and Sewer	**LL1**		1
				5.1	**Community Resources**	Basic Community Resources / Public Transportation	**LL1**		1
				5.2	**& Public Transit** ***OR***	Extensive Community Resources / Public Transportation	**LL1**		2
				5.3	***OR***	Outstanding Community Resources / Public Transportation	**LL1**		3
				6	***Access to Open Space***	Publicly Accessible Green Spaces	**LL1**		1
0				Sub-Total					
Y / Pts	No	N/A							
Sustainable Sites (SS)						(Minimum of 5 SS Points Required)	OR		**21**
y				1.1	**Site Stewardship**	Erosion Controls (During Construction)			Prerequisite
				1.2		Minimize Disturbed Area of Site			1
y				2.1	**Landscaping**	No Invasive Plants			Prerequisite
				2.2		Basic Landscaping Design			2
				2.3		Limit Turf			3
				2.4		Drought Tolerant Plants			2
				3	**Shading of Hardscapes**	Locate and Plant Trees to Shade Hardscapes			1
				4.1	**Surface Water Management**	Design Permeable Site			4
				4.2		Design and Install Permanent Erosion Controls			2
2				5	**Non-Toxic Pest Contro**	Select Insect and Pest Control Alternatives from List			2
				6.1	**Compact Development**	Average Housing Density≥ Units / Acre	**LL1**		2
				6.1	***OR***	Average Housing Density≥ 10 Units / Acre	**LL1**		3
				6.3	***OR***	Average Housing Density≥ 20 Units / Acre	**LL1**		4
2				Sub-Total					
Y / Pts	No	N/A							
Water Efficiency (WE)						(Minimum of 3 WE Points Required)	OR		**15**
				1.1	**Water Reuse**	Rainwater Harvesting System			4
				1.2		Grey Water Re-Use System			1
				2.1	**Irrigation System**	Select High Efficiency Measures from List			3
				2.2		Third Party Verification			1
				2.3	***OR***	Install Landscape Designed by Licensed or Certified Professional	**WE 2.2**		4
				3.1	**Indoor Water Use**	High Efficiency Fixtures (Toilets, Showers, and Faucets)			3
				3.2	**OR**	Very High Efficiency Fixtures (Toilets, Showers, and Faucets)	**WE 3.1**		6
0				Sub-Total					

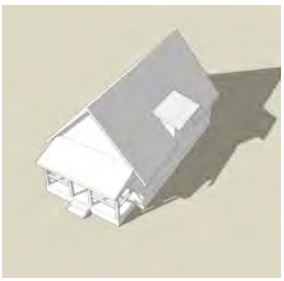
Project Checklist (cont'd)

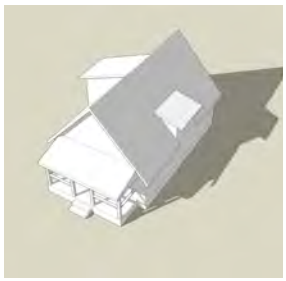
HERS Index Value Achieved: 65
IECC Climate Zone: 4

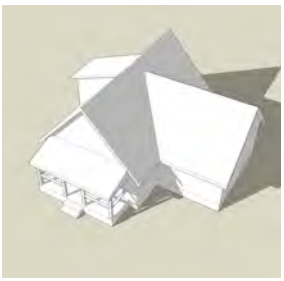
EA 1.2 Pts Achieved: 15.5

Y / Pts	No	N/A							
Energy and Atmosphere (EA)					(Minimum of 0 EA Points Required)		OR		**38**
y				1.1	**ENERGY STAR Home**	Meets ENERGY STAR for Homes with Third-Party Testing			Prerequisite
15				1.2		Exceeds ENERGY STAR for Homes		**EA 2-10**	34
2				7.1	**Water Heating**	Improved Hot Water Distribution System			2
				7.2		Pipe Insulation			1
				11	**Refrigerant Management**	Minimize Ozone Depletion and Global Warming Contributions			1
17			Sub-Total (or Sub-Total from Adendum A - Prescriptive EA Credits)						
Y / Pts	No	N/A							
Materials and Resources (MR)					(Minimum of 2 MR Points Required)				**14**
y				1.1	**Material Efficient Framing**	Overall Waste Factor for Framing Order Shall be No More than 10%.			Prerequisite
3				1.2		Advanced Framing Techniques			3
				1.3		***OR*** Structurally Insulated Panels		**MR 1.2**	2
y				2.1	**Environmentally Preferable**	Tropical Woods, if Used, Must be FSC			Prerequisite
				2.2	**Products**	Select Environmentally Preferable Products from List			8
y				3.1	**Waste Management**	Document Overall Rate of Diversion			Prerequisite
1				3.2		Reduce Waste Sent to Landfill by 25% to 100%			3
4			Sub-Total						
Y / Pts	No	N/A							
Indoor Environmental Quality (IEQ)					(Minimum of 6 IEQ Points Required)		OR		**20**
				1	**ENERGY STAR with IAP**	Meets ENERGY STAR w/ Indoor Air Package (IAP)		**IEQ2-10**	11
y				2.1	**Combustion Venting**	Space Heating & DHW Equip w/ Closed/Power-Exhaust		**IEQ 1**	Prerequisite
2				2.2		Install High Performance Fireplace		**IEQ 1**	2
1				3	**Moisture Control**	Analyze Moisture Loads AND Install Central System (if Needed)		**IEQ 1**	1
y				4.1	**Outdoor Air Ventilation**	Meets ASHRAE Std 62.2		**IEQ 1**	Prerequisite
				4.2		Dedicated Outdoor Air System (w/ Heat Recovery)		**IEQ 1**	2
1				4.3		Third-Party Testing of Outdoor Air Flow Rate into Home			1
y				5.1	**Local Exhaust**	Meets ASHRAE Std 62.2		**IEQ 1**	Prerequisite
1				5.2		Timer / Automatic Controls for Bathroom Exhaust Fans		**IEQ 1**	1
1				5.3		Third-Party Testing of Exhaust Air Flow Rate Out of Home			1
y				6.1	**Supply Air Distribution**	Meets ACCA Manual D		**IEQ 1**	Prerequisite
				6.2		Third-Party Testing of Supply Air Flow into Each Room in Home			2
y				7.1	**Supply Air Filtering**	≥ 8 MERV Filters, w/ Adequate System Air Flow		**IEQ 1**	Prerequisite
				7.2		***OR*** ≥ 10 MERV Filters, w/ Adequate System Air Flow			1
				7.3		***OR*** ≥ 13 MERV Filters, w/ Adequate System Air Flow			2
				8.1	**Contaminant Control**	Seal-Off Ducts During Construction		**IEQ 1**	1
				8.2		Permanent Walk-Off Mats *OR* Shoe Storage *OR* Central Vacuum			2
				8.3		Flush Home Continuously for 1 Week with Windows Open			1
y				9.1	**Radon Protection**	Install Radon Resistant Construction if Home is in EPA Zone 1		**IEQ 1**	Prerequisite
				9.2		Install Radon Resistant Construction if Home is not in EPA Zone 1		**IEQ 1**	1
y				10.1	**Garage Pollutant Protection**	No Air Handling Equipment OR Return Ducts in Garage		**IEQ 1**	Prerequisite
				10.2		Tightly Seal Shared Surfaces between Garage and Home		**IEQ 1**	2
				10.3		Exhaust Fan in Garage			1
3				10.4		***OR*** Detached Garage or No Garage		**IEQ 1**	3
9			Sub-Total						
Y / Pts	No	N/A							
Awareness and Education (AE)					(Minimum of 0 AE Points Required)				**3**
y				1.1	**Education for Homeowner**	Basic Occupant's Manual and Walkthrough of LEED Home			Prerequisite
				1.2	**and/or Tenants**	Comprehensive Occupant's Manual and Multiple Walkthroughs / Trainings			1
				1.3		Public Awareness of LEED Home			1
				2.1	**Education for Building Mgrs**	Basic Building Manager's Manual and Walkthrough of LEED Home			1
0			Sub-Total						
36			**Project Totals (pre-certification estimates)**						*130*

BSC Greensburg Building America House Prototypes







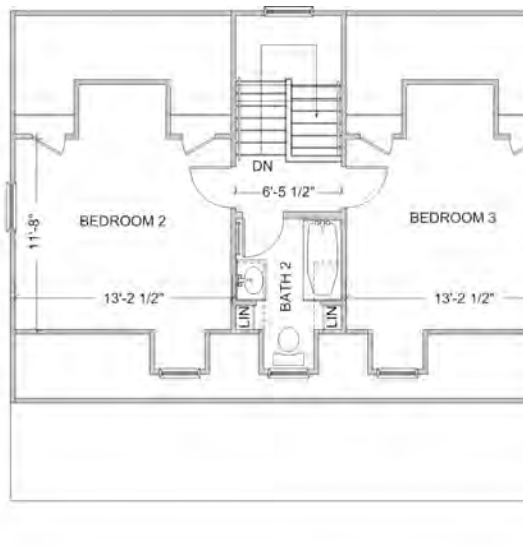
House Plan		**Greensburg Standard**	**Greensburg Plus**	**Greensburg "L"**
Description		Two-bedroom house with living area on the main floor. Second floor can be renovated into two bedrooms.	Three-bedroom version of the Standard with a second bathroom under a new dormer.	Three-bedroom house with "Great Room" and study on the ground floor, 3 bedrooms and second bath on the second floor
Living Area	Ground Floor	750 sq ft	750 sq ft	1050 sq ft
	Second Floor	500 sq ft	500 sq ft	800 sq ft
	Total	**1250 sq ft**	**1250 sq ft**	**1850 sq ft**
Bedrooms	Ground Floor	1	1	0
	Second Floor	1	2	3
	Total	**2**	**3**	**3**
Number of Bathrooms		1	2	2
Options	A -	Engineered Truss Roof: -remove bedroom on second floor, house becomes 1 bedroom, 1 bathroom, 750 sq ft total		Master Bedroom on Ground Floor: -Great Room replaced by ground floor master bedroom, 2-bedrooms above, 1550 sq ft total
	B -	Trusses and Addition: -as above except that the "L"-shaped addition is added, house becomes 2 bedrooms, 1 bathroom, 1050 sq ft total		

BSC Greensburg Building America – Sample Floor Plans ("Greensburg Plus" shown)

BSC Greensburg Building America – Similar Plans Built in Pontiac, MI (below)

BSC Greensburg Building America – Second Plan Example

Ground Floor Plan



Second Floor Plan

Building Science Consulting 70 Main Street Westford, MA 01886 P: 978.589.5100 F: 978. 589.5103 www.buildingscience.com

Residential Energy Efficiency Resources Available From DOE

Technical support Is now available in Greensburg from the U.S. Department of Energy to provide residents of Greensburg with assistance related to the energy efficient rebuilding of their homes. DOE has asked NREL and two Building America teams, BSC and IBACOS to work directly with the city, homeowners, builders, subcontractors and other local groups and agencies to assist in the design and construction of homes with higher levels of energy efficiency levels than a basic code complying home. Energy efficient homes cost less to own and operate than standard homes and improve overall housing affordability and durability.

Building Science Corporation (BSC) will be providing a series of onsite workshops to discuss construction details for affordable, efficient homes. The NREL "Building Greensburg" workshops will provide information on affordable, durable and energy-efficient house construction to support builders and residents re-building homes in Greensburg. Interested builders, building officials, and local and state organizations are encouraged to attend. On September 8th, Joseph Lstiburek and Alex Lukachko from Building Science Corporation (BSC) will give an introduction to the program, an overview of building science for energy efficient houses, and a discussion of foundation system best practices. The workshop will begin at 9am at the "Public Meeting Room" in Greensburg. Interested parties can register online for the workshops at www.buildingamerica-greensburg.com or by contacting Jeff Melvin at jeff@buildingscience.com or (978) 589-5100. For more information about this free seminar series, please contact Alex Lukachko (BSC) at 978.589.5100, or Ren Andersen (NREL) at 303.384.7433.

In addition to the free workshop series provided by BSC, Duncan Prahl, an architect, and John Holton, an architect and engineer will be available in Greensburg on a regular basis over the next 8 months to provide onsite support. Duncan and John come to us from IBACOS, a company that has been working for DOE and NREL through the Building America Program (www.buildingamerica.gov) to develop and implement cost effective energy efficient building techniques across the US. They will be setting up their office in the temporary buildings on Oak St. Duncan and John can be reached at 620-210-0281, or via email at dprahl@ibacos.com or jholton@ibacos.com.

The DOE Residential Team, including NREL, BSC, and IBACOS, are here to help make your residential reconstruction projects a success, and are ready to meet with you or your builder to discuss your rebuilding plans.

About this Report

This report was prepared with the cooperation of the U.S. Department of Energy's, Building America Program.

About the Author

Joseph Lstiburek, Ph.D., P.Eng., is a principal of Building Science Corporation in Westford, Massachusetts. Joe is an ASHRAE Fellow and an internationally recognized authority on indoor air quality, moisture, and condensation in buildings. More information about Joseph Lstiburek can be found at www.buildingscienceconsulting.com.

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